Aviation Week

Including **Space Technology**

MAY 19, 1958

Fusion Offers Powerplant for Space Flight

North American A3J Attack Plane

advanced

ORD NCE

Research and Engineering at Rheem have been instrumental in developing the new concept of "advanced ordnance"... employing a broad and perceptive approach to the changing requirements in the ordnance field. Current and completed programs include the concept, analysis, development, testing and prototype manufacturing of guided missile warheads/fuzing/mine warfare systems/practice bombs/antipersonnel weapons/ground handling equipment/target rockets. The application of "systems management" to ordnance requirements has yielded integrated ordnance products adapted to current military needs.

Rheem, Downey, California, is a division of world-wide Rheem Manufacturing Company which operates 17 plants in the United States... and with its associated and licensed companies operates 18 plants in 12 countries abroad. These extensive facilities coupled with Rheem's years of ordnance production experience provide the capability for the quantity production of ordnance products and systems.

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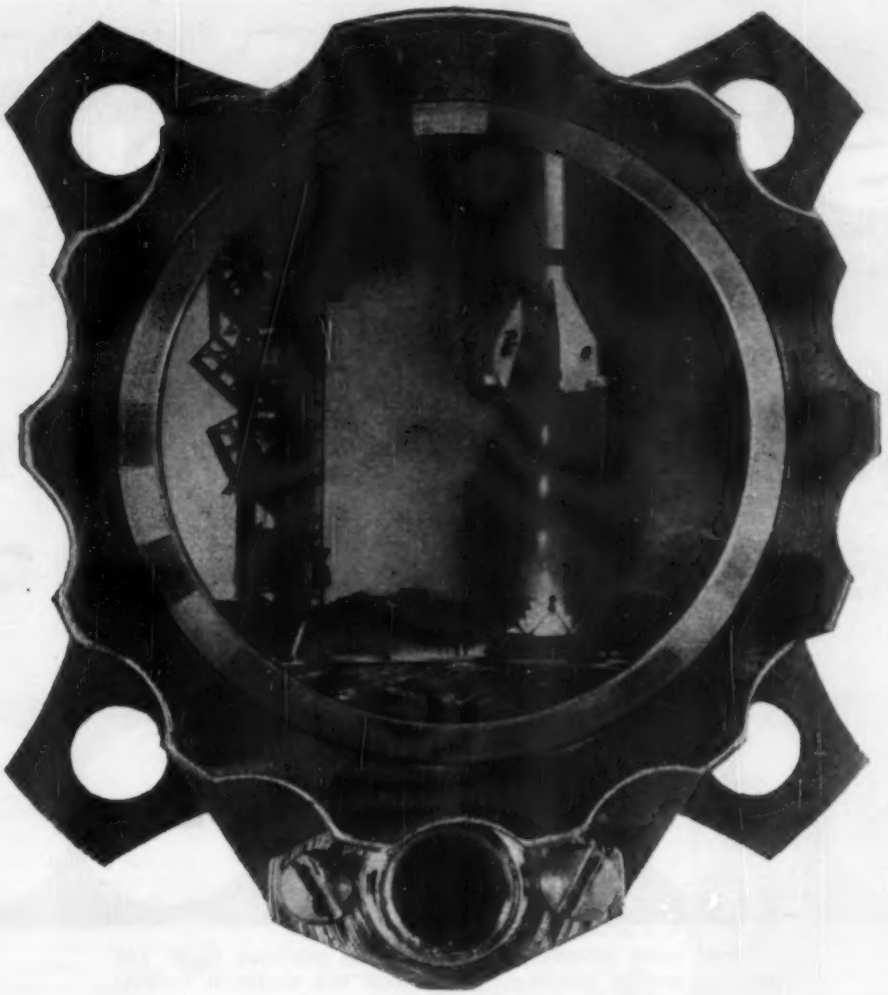
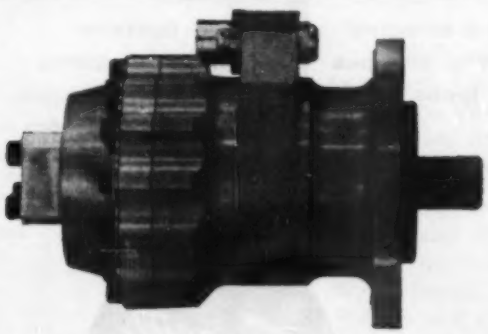


NOW you can order missile hydraulic pumps from HYDRO-AIRE



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Pressure—3000 psi
Speed—9000 rpm
Weight—21 ounces

Hydro-Aire—a name you know and rely on for quality airborne controls—announces the development of a new lightweight high pressure positive displacement hydraulic pump designed specifically for the missile industry. Pre-tested in Hydro-Aire's development laboratory, this new pump has demonstrated high efficiency performance over a life span that exceeds known missile application requirements. The unit is ready for quantity production and can be easily adapted to your particular specifications.

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SARGENT

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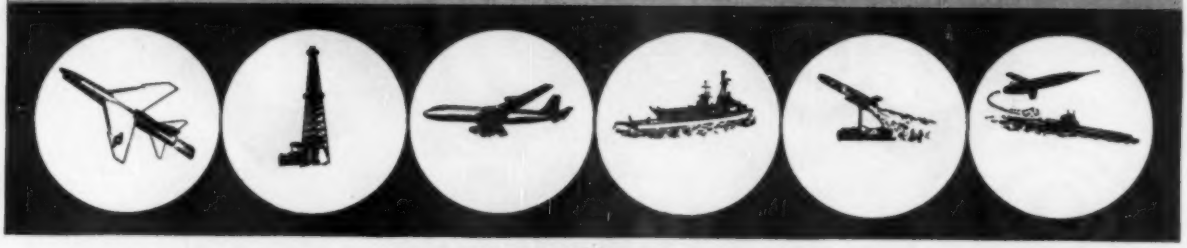

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"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

May 25-31—1958 Aviation Writers Assn. Convention, the Shamrock Hilton, Houston, Tex.

June 2-4—National Telemetering Conference, Lord Baltimore Hotel, Baltimore, Md.

June 4—Business Aircraft Conference, sponsored by Chicago Assn. of Commerce and Industry, Hotel Sherman, Chicago, Ill.

June 4-5—West Coast Magnesium Symposium, correlated program by the Society of Aircraft Materials and Process Engineers and the Magnesium Assn., Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.

June 4-6—Second National Conference on Production Techniques, sponsored by the Institute of Radio Engineers Professional Group on Production Techniques, Hotel New Yorker, New York, N. Y.

June 5-6—13th Annual National Meeting, Armed Forces Chemical Assn., Hotel Traymore, Atlantic City, N. J.

June 9-12—American Rocket Society Semi-annual Meeting and Astronautical Exposition, Hotel Statler, Los Angeles, Calif.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, New York, N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 19-21—Annual Meeting, Institute of Navigation, University of California Santa Barbara College, Goleta, Calif.

June 22-27—61st Annual Meeting, American Society for Testing Materials, Hotel Statler, Boston, Mass.

June 22-27—Summer General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Statler Hotel, Buffalo, N. Y.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount

(Continued on page 6)

AVIATION WEEK Including Space Technology

May 19, 1958
Vol. 68, No. 20

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AVIATION CALENDAR

(*Continued from page 5*)

Washington Hotel, Bretton Woods, N. H.

June 27—First Water-Based Helicopter Symposium, sponsored by the Bureau of Aeronautics and Stevens Institute of Technology, Stevens Institute of Technology, Hoboken, N. J.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Ohio.

July 24-25—Quarterly Regional Meeting, Assn. of Local and Territorial Airlines, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Jointly sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 8-13—Dynamics of Flight, University of Michigan, intensive course for practicing engineers, Ann Arbor, Mich.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

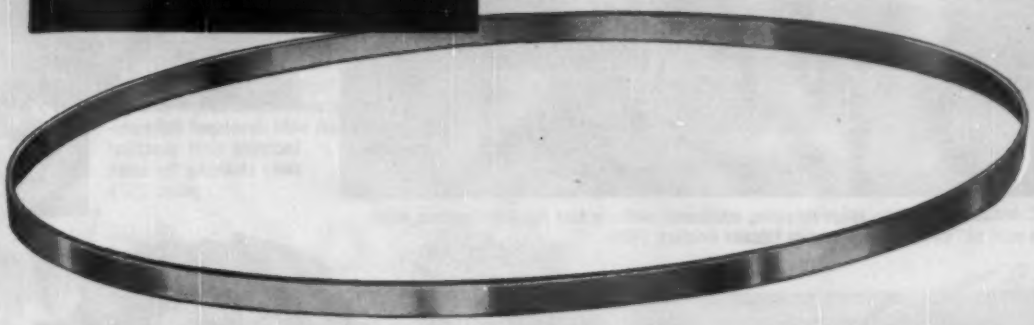
Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 29-Oct. 3—National Aeronautic Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles, Calif.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, sponsored by the Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Precision Rings with little or no machining



Today you can purchase precision flash butt-welded rings that require little or no machining to meet your specifications. Made from bar stock of finished gauge, they can be produced to meet the same tolerances as conventionally machined rings. Cost of production and materials of some rings has been reduced as much as 60%. Sizes and materials at present are limited to those bar stocks which can be furnished to precise finished dimensions. However, persistent efforts of American Welding engineers and the producers of finished bars give promise of a widening range of sizes and metals that can be manufactured by precision forming and welding.

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ARC installed first radio range receiving equipment, with six foot rigid rod antenna, which was used on "Mailwing" biplanes by Pitcairn Aviation, 1928.

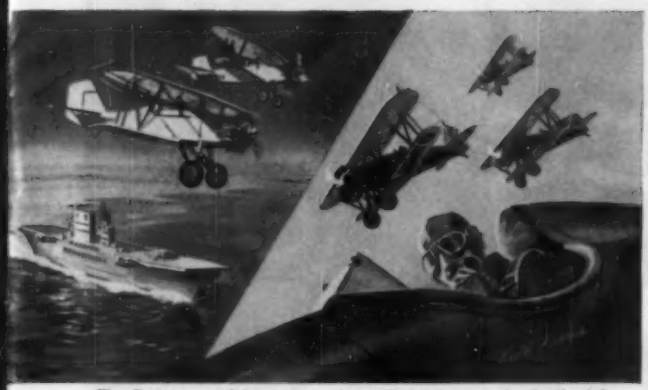
ARC developed and manufactured first practical radio shielding for spark plugs, 1929.

ARC's laboratory and flying field at Boonton, N. J., 1929.

ARC radio range receiving equipment went to Antarctica with Admiral Byrd on polar expedition aboard his Ford Tri-motor, 1929.

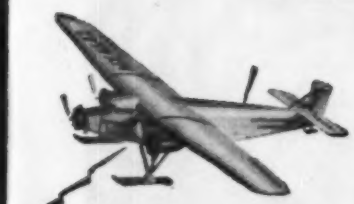
First Blind Flight was by Jimmy Doolittle in aircraft equipped with ARC radio range receiver, 1929.

Early radio altimeter work was carried on by ARC in 1929.



The first successful two-way voice radio equipment standardized for use on Army and Navy fighter aircraft was another important ARC communications development, 1931.

ARC designed first beacon receivers for Douglas M-2 mail planes of National Air Transport, later part of United Air Lines. An historic milepost in the development of today's radio aids to navigation.



CELEBRATING 30 YEARS
OF PROGRESS IN AIRBORNE ELECTRONICS

Pilots wore goggles in 1928 . . . cockpits were open to the weather and biplanes still resembled box kites. Flying the Atlantic was so new it was front page news and air mail routes were the newest thing in communications. That was the year a group of radio engineers got together to develop instruments to help pilots navigate with more precision than "seat of the pants" flying.

That's when Aircraft Radio Corporation was born.

On these pages some of the organization's accomplishments over the past 30 years are noted, along with a few of today's precision instruments of navigation and communications.

These are the mileposts that testify to a rich fund of experience and engineering skill . . . of a group dedicated to the science of airborne electronics for greater safety and progress in aviation.

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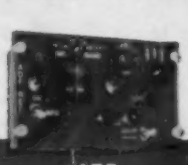


ARC
TYPE 21A
DIRECTION FINDER

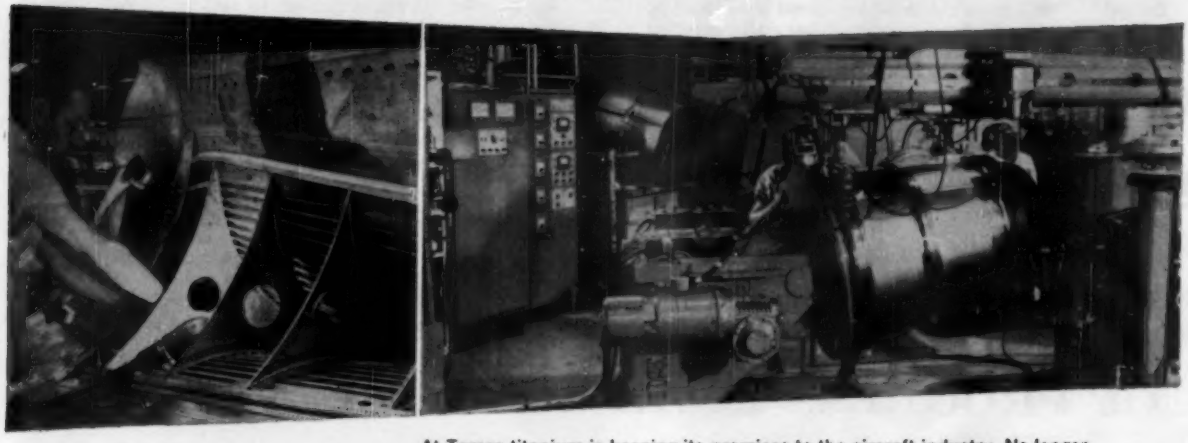
ARC
COURSE DIRECTOR CD-1
WITH DUAL OMNI 15-D

ARC
TYPE H-14A
SIGNAL GENERATOR

ARC
TYPE 210 360-CHANNEL
TRANSCEIVER

Temco | AIRCRAFT DALLAS

..TITANIUM and TOMORROW



At Temco titanium is keeping its promises to the aircraft industry. No longer the intransigent metal, titanium in precision assemblies has become routine here. Through the development of Temco's Ti-Brite process, the tough titanium scale which once limited the material's usefulness is electrolytically removed without etching or disturbing the most precise dimensions.

And at Temco a successful process for chrome-plating titanium may be the major break-through in the feasibility study for extending its temperature resistance beyond the 800-1000°F range. Forming, spot welding, precision machining are everyday operations. Temco's proven capabilities in precision automatic fusion welding have proved especially effective in the assembly of titanium parts. A case in point: the front compressor casings of Pratt & Whitney's J-57 engine, produced at Temco.

Quality and reliability of assemblies produced at Temco are assured by the extensive facilities of the Quality Control Department and Metallurgical Laboratory. These include the newest non-destructive spectographic and large X-ray equipment.

Capabilities in advanced metallurgy . . in titanium, aluminum, austenitic steel, stainless steel . . are typical of Temco progress. And now research and development capabilities are challenging the rare earths . . berylium, columbium, tantalum, molybdenum . . for tomorrow's needs. As the aircraft industry grows, so do Temco's capabilities to design, tool and produce for it. **Whether your need is for a component, a subsystem or a complete system . . . an inspection of Temco will be informative and profitable.**

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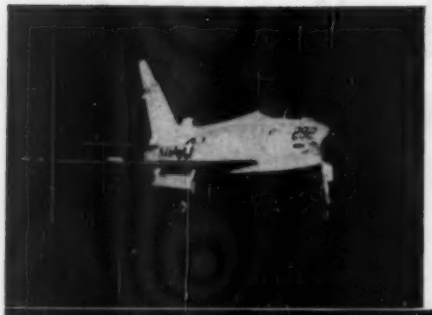

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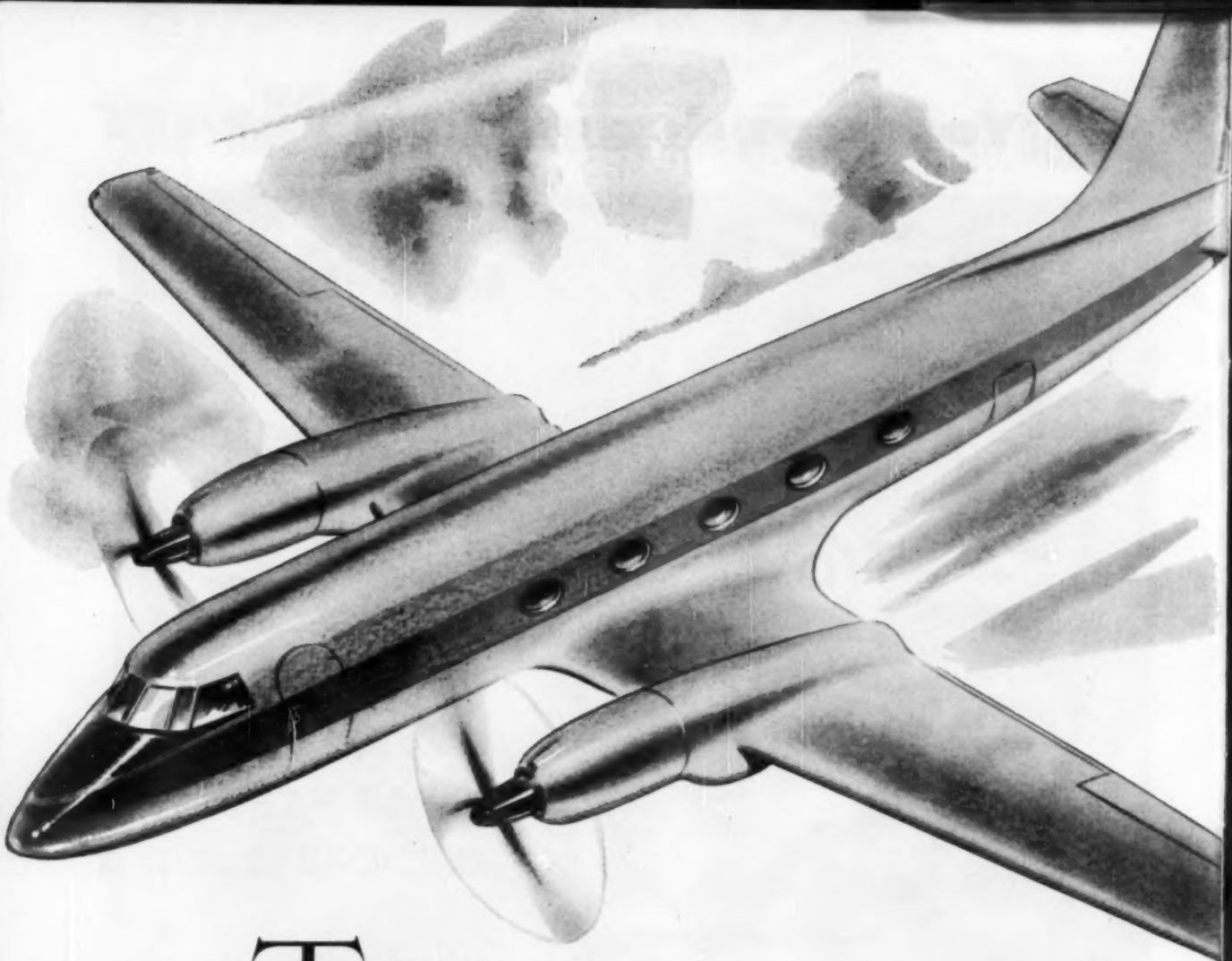
1908–1958 GM FORWARD FROM FIFTY

HYATT HY-ROLL BEARINGS FOR AIRCRAFT INDUSTRY



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Rotol Propellers and Gearboxes have completed millions of flying hours on hundreds of Viscount aircraft throughout the world. Rotol equipment is also associated with the Fokker and Fairchild aircraft and *NOW* . . .

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UHF

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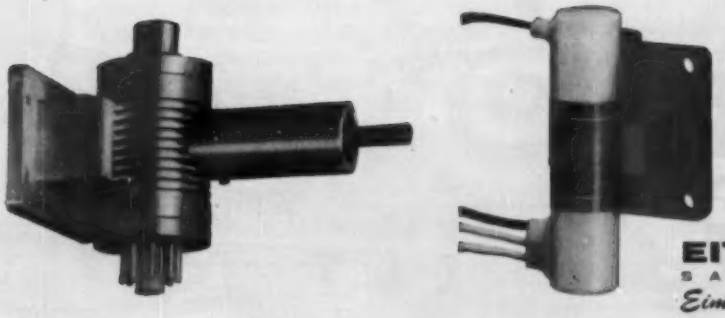
The advantages of reliable Eimac ceramic tubes include: resistance to damage by impact, vibration, and heat; smaller size; and better processing techniques.

SHF



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Guiding a missile, or speeding flight and flight environmental data back to control and tracking centers, is too much of a job for conventional communication systems. Supersonic speeds call for lightning fast data communications, coupled with the utmost reliability.

Capitalizing on the ease of converting messages into digital form, Motorola scientists and engineers have developed a number of Data Link Communications Systems suitable for piloted aircraft, as well as missiles.

NERVE CENTER FOR DATA LINK SYSTEMS

With Data Link Systems, messages that have been translated into on-off pulses can be transmitted by any of the common modulation schemes with a suitable carrier. The transmitter can be air-borne, ship-borne, or land-based. Received messages are amplified, decoded, and transformed into a form suitable for display, or stored for some future time, or used for direct control through auto pilots, for example.

One of the Data Link Systems designed at Motorola utilizes an all-transistor converter-coupler, packaged in modular form. The total system consists of eight modules, each approximately 4" x 8" x 1½". The fully transistorized circuitry is of the highly reliable diode-matrix type logical circuitry used in many digital computers. The switch type transistors employed are a product of the Motorola Semi-Conductor Division. Indicative of the stringent testing program to which the transistors are subjected is a 1000-hour life test at 85° C.

For another Data Link program, Motorola has designed a system featuring resolver-type outputs. A single time-shared servo amplifier positions anyone of the five resolvers in accordance with commands from the ground transmitter.

These two Motorola Data Link Systems aimed at solving one of the important communication problems of the missile age are examples of the complex programs conducted by Motorola for varied military needs.

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MILITARY ELECTRONICS DIVISION

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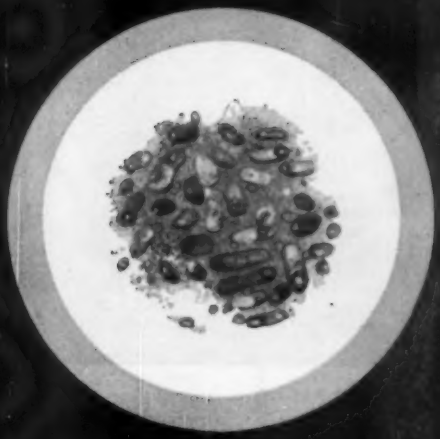

bacteria... bombs... bumblebees

Broad, comprehensive engineering experience is the firm foundation for advanced thinking and scientific development for the future.

Bendix-Pacific has developed unique instrumentation for biological testing . . . created devices which have contributed materially to the state of the bombing art . . . has extensive missile guidance experience dating back to the start of Navy's Bumblebee Program.

Current active developments include servo valves for missiles and their launchers, actuators for turbo prop pitch control, sonic altimeters for low flying aircraft, submarine sonar systems, and high resolution radar for helicopters. These programs provide only a few of the building blocks used at Bendix-Pacific in advanced work on many types of weapons systems.

Exceptional career opportunities for skilled engineers are available. The day-to-day association with challenging problems in many and varied scientific fields at Pacific Division will be rewarding. You are invited to write R. A. Lamm, Director of Engineering, and obtain more information about Bendix-Pacific and your future.

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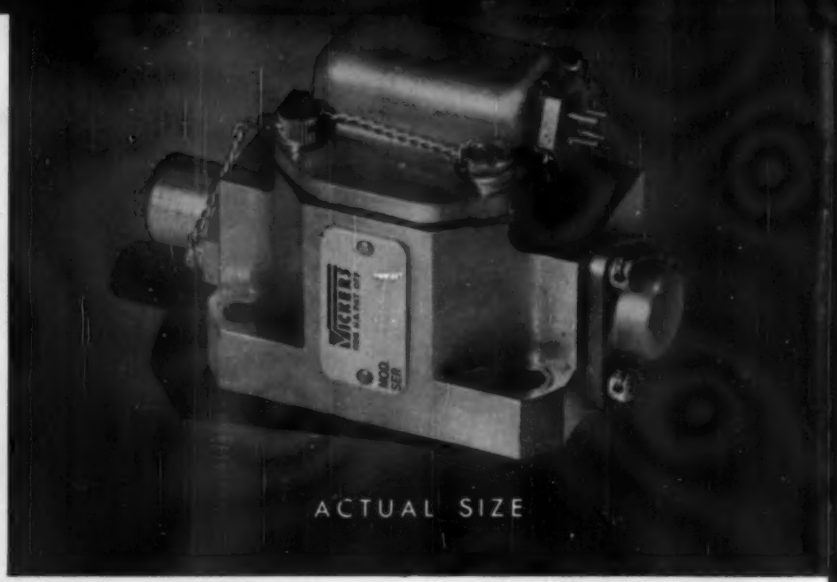

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Administration to Clarify Civil Space Role 26
▶ White House spokesmen propose amendments to NASA legislation to clarify military, and civil space roles.

Qantas Bids For Cut of U. S. Local Market 38
▶ Bid by Australian airline to compete in domestic market could open way for other foreign carriers.

C-130 Demonstrates Mission Flexibility 60
▶ Aviation Week pilot reports on flight characteristics, ease of air-ground handling, all-field capabilities.

SPACE TECHNOLOGY
Space Roles to be Clarified 26
Russians Launch Sputnik III 29
Magnetohydrodynamics—Part 2 50
Photos of Tumbling Sputnik 30

AERONAUTICAL ENGINEERING
C-130 Demonstrates Mission Flexibility 60
First Navy AJ3 Details 27
Navy High Energy Fuel Plant 29
French Reveal Two New Aircraft 79
Italians Pioneer Formation Landing .. 80
USAF Narrows Plane Production 89

AVIONICS
Ducts May Supplement Frequencies .. 95

MISSILE ENGINEERING
G.M. Bids for Minuteman 26
Polaris Test Vehicle Launched 28
Republic Develops Jet Drone 32

FINANCIAL
Aviation Resists Recession Drop 32
Aircraft Executive Pay 33

SAFETY
Mechanic's Error Cited in Bay Landing 98
British Investigate Viscount Crashes .. 31

AIR TRANSPORT
Qantas Asks Local Market Cut 38
New Navigation Units Planned 40
Subsidy Request Filed by Tiger 40
CAA Long Range Radar System 41
Three Lines for Midwest Routes 41
Passenger Decline Cuts Profits 42
Idlewild Instrument Runway 47
Shortlines 43
Airline Observer 45

MANAGEMENT
West Coast Strike Threat Eases 27
Few Defense Changes Foreseen 29
Public Information Office Merger 31
Bomber Cancellation Sparks RAF 34
Civil Air Research Gets Ministry Aid . 37
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 37

Calendar 5
Letters 114

EDITORIAL
Sputnik III and U.S. Space Policy 21

COVER: First photo of Navy's supersonic twin-jet A3J attack aircraft shows flat fuselage shape, squared jet intakes and tandem cockpits. Aircraft is shown in North American Aviation, Inc., Columbus Division production hangar. Note high, thin swept shoulder wing and large speed brakes between main gear. Fitting below forward windshield could be housing for in-flight refueling probe. Additional details on aircraft configuration and rollout are on page 27.

PICTURE CREDITS

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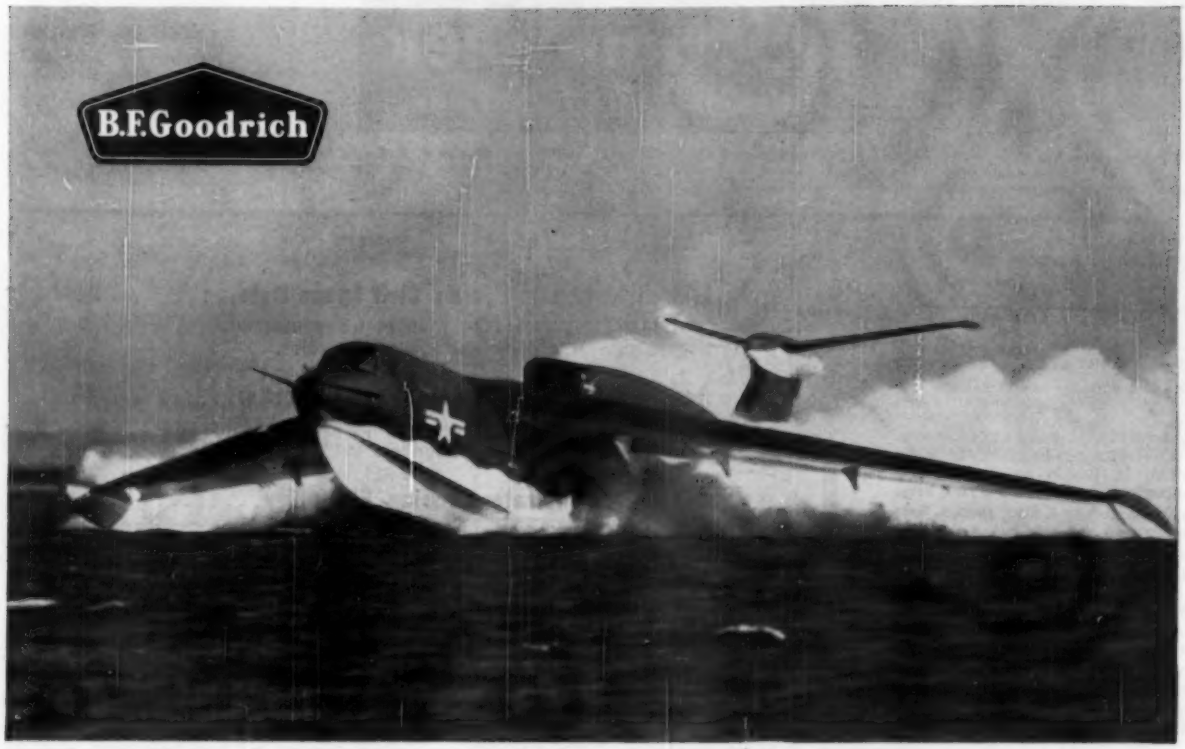

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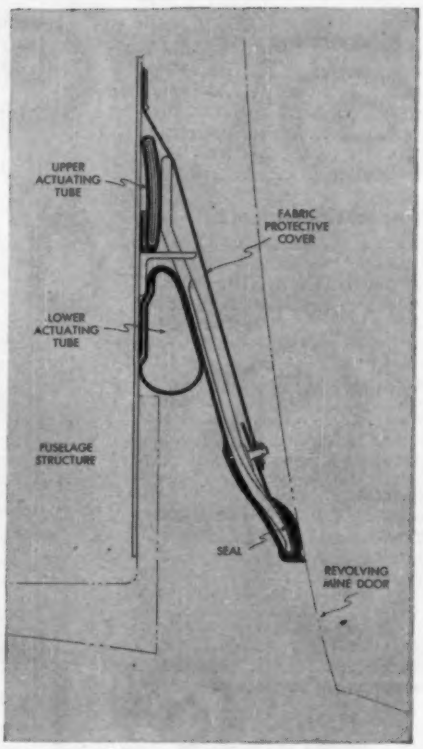
This development is typical of the way B. F. Goodrich engineers work with manufacturers to come up with the right answers for their specific problems. Why don't you outline your engineering problem in a letter to B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Akron, Ohio.



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EDITORIAL

Sputnik III and U.S. Space Policy

Successful launching of the 3,000 lb. Soviet Sputnik III should dispell most of the wishful thinking that has hung over the U.S. space policy since the fiery plunge of Sputnik II into the Caribbean. It proves once again that the Soviets earlier Sputniks were no lucky accidents. It proves that the Soviet space program is a well-organized, consistent effort that is attempting to progress in significant increments rather than simply shooting for some spectacular international propaganda stunt. It also indicates that the Soviet program has solid and consistent support not subject to the ups and downs of top level policy changes or political whims of the moment.

Although few details are available on Sputnik III at this writing, it is obvious that its 3,000 lb. weight put into orbit represents an achievement far beyond anything this country is capable of matching in the immediate future. Even the most optimistic current space exploration plans, none of which have received any official approval yet, do not aspire beyond a 2,000 lb. satellite payload in orbit by 1962. Now sheer weight is not the entire story of a satellite but it is certainly true that the larger payload hurled into orbit the greater opportunity for instrumentation and the greater possibility of significant scientific harvest from its operations.

We are planning to put an infrared "seeing eye" in our next Explorer shot to scan a 600 mile wide band of the earth's weather and cloud cover. It is not unlikely that Sputnik III carries some similar type of equipment bringing the reconnaissance satellite a step nearer to reality.

There have been many speculations as to why the Soviets had a gap in their satellite program from November when Sputnik II was launched until now. One of the most plausible we have heard comes from Krafft Ehricke of Convair who has helped build missiles on two continents. He pointed out that the Soviets are using their ICBM propulsion systems for satellite launching and that at this stage of their development program for these huge rockets there are probably not enough available to fully support both the satellite and weapons development programs simultaneously. We know that the Soviets in March concluded a series of megaton size warhead tests in Siberia for a wide variety of missiles including the ICBM warhead. Therefore it is quite possible that this capability was shifted to Siberia for the warhead tests and after their completion moved back to the satellite launching complex at the main missile test range northwest of the Caspian Sea. It is also logical to assume that as the Soviet satellites get heavier and more complexly instrumented there will be longer intervals between launchings.

Now how have we been faring on the U.S. space program since last fall? The Vanguard program is moving along at a good pace and, contrary to public misconception, it represents a pretty successful program considered in perspective of its inception, administration and technical aims. The Army's Explorers have also made a successful contribution. But both Vanguards and Explorers are still many cuts below the Soviet achievements with Sputniks II and III and no amount of scornful references by U.S. scientists to "dead dogs" can alter this fact. Aside from continuing the Vanguard and Explorer programs we have done precious little about organizing a truly national space policy utilizing all of the best available elements from military research and civilian science.

There is still an intolerable amount of wrangling over who will control what, a basic skepticism in top government levels that space exploration is a waste of time and money, and a continuing tangle of administrative red tape to slow action and strangle decisions. We are still debating in Congress the advisability of establishing a National Aeronautics and Space Agency. We hope Sputnik III will shake some of the Congressional nitpickers out of their lofty perches and prod them into action on this vital measure.

Elsewhere in the government the process of bureaucratic accretion continues. For example, look at all of the agencies that are now in the act on a relatively simple project such as the lunar probes recently authorized for initial exploration of the moon.

We have at least seen the wisdom of using existing and well developed boosters for space exploration so both Thor and Redstone plus existing Vanguard hardware will be used. But say we start at Douglas who makes the Thor and Aerojet and who makes the second stage Vanguard. From there the administrative web goes to the Air Force Ballistic Missiles Division in Los Angeles through the Ramo-Wooldridge space technology laboratory to the Advanced Research Projects Agency in the Pentagon. But here ARPA has to consult with Dr. Paul Foote, assistant secretary of defense for research and applied engineering and William Holaday, the Pentagon missile czar whose approval is required before missiles can be allocated for scientific purposes. Then ARPA has to get the blessing of Dr. James Killian, the President's scientific adviser, and the anonymous staff who advises him. All of these bases must be touched to get a decision and once the decision is reached, the flow begins in reverse.

Even outside this tortuous orbit the Army, Navy and Air Force are engaging in an unseemly and unproductive effort to grab as much of the space mission for their respective services as possible. And within the Air Force at least three factions are bitterly scrambling for control of the bio-satellite program, just one piece of the over-all effort. Meanwhile the scientific talent and the engineering know-how of American industry, evidenced in at least a hundred practical space exploration proposals gathering Pentagon dust, are stymied by this incredible governmental maze.

—Robert Hotz

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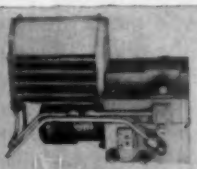

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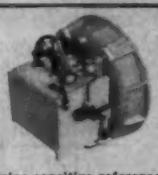

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In the Front Office

Peter F. Hurst, a director, Clark Equipment Co., Jackson, Mich. Mr. Hurst is president of Aeroquip Corp.

M. B. Ruffin and **Samuel Bousky,** directors, Chicago Aerial Industries, Inc., Melrose Park, Ill. Mr. Ruffin is the company's vice president and general manager; Mr. Bousky is director of engineering.

Fred J. Kirkman succeeds **Dan W. Hirtle** as president, Burgess Battery Co., Freeport, Ill. Mr. Hirtle is now vice chairman of the board.

L. G. Porter, president and general manager, Long Manufacturing Division, Borg-Warner Corp., Detroit, Mich., and Long Manufacturing Co. Ltd. of Canada.

Robert J. Sloan succeeds **J. R. Tuttle** as president, Crouse-Hinds Co., Syracuse, N. Y. Mr. Tuttle continues as board chairman.

H. H. Clarke, Jr., president and **George McC. Joyce,** executive vice president, Dyna-Therm Chemical Corp. (formerly Ideal Chemical Products, Inc.), Culver City, Calif.

Earl R. Skaggs, executive vice president, Townsend Engineered Products, Inc., Santa Ana, Calif.

Capt. Charles E. Trescott (USN, Ret.), vice president and general manager, Zenith Plastics Co., Gardena, Calif.

Vernon A. Johnson, a vice president, Lockheed Aircraft Corp., Burbank, Calif. Mr. Johnson continues as director-corporate outside offices, with headquarters in Washington, D. C.

Joseph A. Anderson, a vice president, General Motors Corp., Flint, Mich. Mr. Anderson is general manager of AC Spark Plug Division.

Hayes Dever, vice president and secretary, Capital Airlines, Inc.

G. Ward Hobbs, assistant vice president-operations services, American Airlines, Inc.

Leon Adida will head the French Air Force Technical and Industrial Direction (D.T.I.), one of the highest and most significant Civil Service posts in French aviation, replacing Louis Meyer, resigned.

Clarence J. Stock, Technical Adviser on Air Traffic Control, Airways Modernization Board, Washington, D. C.

Dr. John Harry Williams, University of Minnesota physicist, appointed Director-Research Division, Atomic Energy Commission, Washington, D. C.

Honors and Elections

Brig. Gen. Harold R. Harris (USAF, Ret.) has been elected president of the Wings Club, New York City, succeeding **Vice Adm. C. E. Rosendahl** (USN, Ret.). **Adm. John H. Cassaday** (USN, Ret.), **Joseph S. Harris** and **Robert W. Tuttle** were elected vice presidents.

Richard S. Morse, president of National Research Corp., has been appointed Chairman of the Army Scientific Advisory Panel.

James H. Carmichael, Capital Airlines' board chairman, received one of the American Schools and Colleges Assn.'s Horatio Alger Awards for 1958.

(Continued on p. 105)

INDUSTRY OBSERVER

► Air Force probably will issue general specifications for a Man-in-Space Soonest program (MIS) within the next few weeks followed by a call for specific proposals in accordance with the specifications shortly afterwards. All previous proposals have been made by industry on a voluntary basis since there has been no official request from USAF. Program will aim initially only at the survival of man in a capsule. On the first flight, he will not be expected to operate any controls. He will test his ability to function by attempting to press buttons with his fingertips. Crew member also will be free to make other controlling movements if he is able to do so, but no hand or arm movements will be necessary for the first trip into space to be considered successful.

► Air Force plans two additional Thor-Able firings from Cape Canaveral, each carrying a mouse. Tests will check re-entry, acceleration, engine combination and separation techniques. Nose cone from the first Thor-Able shot (AW April 28, p. 37) was not recovered because the second stage of the test vehicle failed to separate from the nose cone, and the flotation gear for the cone had no chance to operate.

► Wright Air Development Center request for industry proposals on three types of space navigation systems—one for controlling attitude and orbit of recoverable satellite, another for a system suitable for making a lunar landing and a third designed for interplanetary travel—has produced 250 proposals from approximately 100 companies.

► Air Force Ballistic Missile Division's lunar probe vehicle will incorporate a Douglas Thor plus a modified Vanguard second stage and a third stage, possibly a modification of Grand Central Rocket Co.'s Vanguard third stage. Another possibility for the third stage is a liquid propellant hydrazine-flourine engine now under study by the National Advisory Committee for Aeronautics. All BMD lunar probes will be of the same configuration and carry the same payload, which will be less than 50 lb. However, they will be fitted with different instrumentation for different measurements. None of the probes are intended for moon impact. In order to obtain maximum information, the object is to get the probes to circle the moon, return and burn up as they re-enter the earth's atmosphere or to orbit the moon. No camera will be carried and all data will be telemetered back.

► North American X-15 high-altitude research vehicle will be carried to initial altitude under the right wing of a Boeing B-52 bomber. Trailing edge of the B-52 wing will have a cutout section to accommodate the X-15's vertical stabilizer.

► Operating contract for instrumentation of the 500-mi. missile range extending from the Pacific Missile Range to Dugway, Utah (AW March 17, p. 21) has been awarded to Chance Vought Aircraft, Inc.

► Female staff member of Wright Air Development Center's Aero-Medical Laboratory recently completed a seven-day simulated space mission in complete darkness and isolation in a small, soundless (anechoic) chamber without apparent adverse isolation effects. Previous tests in anechoic chamber with male subjects ran for periods of up to approximately three days.

► First Royal Air Force personnel scheduled to operate the Douglas Thor intermediate range ballistic missile are slated to arrive at Cooke AFB, Calif., for training in July.

► Chance Vought Regulus II cruise missile is now being fired on a weekly basis from Navy-managed Pacific Missile Range, Pt. Mugu, Calif. Company hopes to beat the present 1960 fleet delivery date by as much as six months. It also is still hopeful of interesting the Air Force in the Regulus II as either an air-to-ground or ground-to-ground weapon.

► Reconnaissance satellite equipped for infrared and/or television scanning is being developed for the Army by Radio Corp. of America's newly formed Astro-Electronics Division.

ANTI-MISSILE SYSTEMS

A Research Project of Dr. Harry Nyquist, Senior Scientist, Stavid Engineering, Inc.

Dr. Nyquist is a pioneer in advanced areas of electronics such as Information Theory and circuit noise, and is credited with nearly 150 patents in the field of communications. He is now contributing his exceptional analytical ability to Stavid's work on a far reaching anti-missile system. Men like Dr. Nyquist are typical of Stavid's outstanding scientists and engineers who are working on advanced concepts ... years ahead of actual systems development.

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Washington Roundup

ARDC Reviews Needs

Major review of Air Research and Development Command's estimates of technical needs for the next 10-20 years will continue June 23-Sept. 6 at Woods Hole, Mass., under contract to the National Academy of Sciences. Aim is to produce a blueprint that will allow revolutionary, rather than evolutionary, action in the planning of technical programs, facilities, manpower, etc., to help assure the nation's air and spacepower supremacy.

Studies are taking into account the needs of other government agencies, industry and universities, as well as Air Force. First summer study last year involved 103 scientists from 26 universities, 20 industrial firms and eight government agencies.

Renegotiation Dissatisfaction

Industry dissatisfaction with the administration of the Renegotiation Act and ways of combating it will be some of the major subjects to confront the annual conference of the Aircraft Manufacturing Council of the Aircraft Industries Assn. next week at its annual meeting in Williamsburg, Va. The AIA board of governors also will hold one of its biennial meetings during the conference, which begins on May 21. Approximately 140 council members and guests are expected to attend the conference.

Accrued Expenditure Bill

Outlook is that legislation providing for the establishment of annual ceilings on defense expenditures—as well as the expenditures for other government activities—will be allowed to quietly die. The measure has been passed by both the House and Senate, but there are major differences between the two versions. Main opposition to proposal came from members of House Appropriations Committee who argued that it is impossible to set a ceiling on defense spending a year in advance.

Independent CAA

Members of the Senate Commerce Committee, spurred by crashes of airlines with military jets, have opened a drive for legislation establishing an independent federal aviation agency. The committee staff is now drafting the measure. Sen. Mike Monroney (D.-Okla.), chairman of the commerce aviation subcommittee, commented:

"We will propose an independent agency reporting directly to the President, and not organized as a subordinate branch of another government department.

"We contemplate that the agency will have representatives of the military aviation branches as a part of it, but that it will have a single civilian administrator, who will have the power, after adequate consultation, advice, study, and technical help, to make final decisions. Unless such power is granted soon, air travel is going to become dangerous."

The main issue appears to be timing. Elwood Quesada, chairman of the Airways Modernization Board, is scheduled to submit a plan for an independent federal aviation agency to Congress next January.

Near-Miss Report

Civil Aeronautics Board told Congress yesterday that near-misses reported during 1957 totaled 971 and that the number of actual midair collisions during the past decade reached 159 with fatal injuries to 402 persons. Statistics involving the collision accidents, the Board reported, showed that clear weather prevailed in 94% of the cases.

Visibility was more than three miles in 98% of the accidents and 94% of them occurred in daylight. In a special supplemental report to Congress, the Board reviewed its recent efforts to tighten control of airspace to reduce the collision hazard but warned that the introduction of positive control with facilities now available would "instantly ground 85% of traffic."

However, the Board said its goal is a rapidly expanding traffic control system "which assures where necessary the separation of planes in good and bad weather." The Board warned that freedom from unnecessary restriction and safe separation of aircraft sometimes conflict and concluded: "In such cases, the Board's duty is to develop regulations which best serve the needs of air commerce, the postal service and the national defense."

Military Paybill

Both the House and Senate last week approved a military pay raise plan calling for an outlay of $576 million a year as an incentive to keep trained and skilled personnel in the armed services. The increases ranged from 1% boost in the lower enlisted grades to 33% for top-ranking generals and admirals. The bill also creates additional grades and provides for additional increases for proficiency. The Defense Department estimates 2,592,000 persons will receive increases under the bill. This includes 1,682,000 on active duty; 700,000 on reserve, and 210,000 retired.

Space Attendance

One of the most enthusiastic committees on Capitol Hill is the House Committee on Astronautics and Space Exploration. Each session has been attended by a majority of the members since hearings began April 15.

Six of the 13-man committee have not missed a session, although they are all members of one or more other House committees of major importance. The six are chairman John McCormack (D.-Mass.), William Natcher (D.-Ky.), B. F. Sisk (D.-Calif.), James Fulton (R.-Penn.), Kenneth Keating (R.-N.Y.) and Gerald R. Ford, Jr. (R.-Mich).

Most of the remaining members have attended at least two-thirds of the meetings.

On the Senate Space Committee, it is not unusual to see only one member in attendance. After the opening session, attendance has been small throughout the two weeks of hearings. However, the members of the committee serve on as many as five other committees.

Bilateral Opposition

Rep. Isidore Dollinger (D.-N. Y.) is urging the Civil Aeronautics Board and the State Department to "take a long hard look" at any further air transport negotiations with foreign governments that would continue to endanger U.S. airlines. He said in a recent trip to Miami he noticed foreign flag airlines outnumbered U.S. international carriers almost 10 to one.

—Washington staff

Space Technology

Administration to Clarify Civil Space Role

White House spokesmen propose amendments to legislation to clarify military and civil space roles.

By Ford Eastman

Washington—Administration spokesmen last week proposed "perfecting" amendments to the proposed space bill, including a language change that would clarify military and civilian roles in the national space program.

Roles and missions of the military versus those of a civilian space agency have been some of the major issues raised before both the House and Senate space committees during five weeks of open hearings.

The Senate Committee on Space and Astronautics headed by Sen. Lyndon Johnson (D.-Tex.) concluded hearings last week and will go into executive session to consider legislation. The House Committee on Astronautics and Space Exploration headed by Rep. John McCormack (D.-Mass.) plans to report a bill out by this week.

Maurice H. Stans, director of the Budget Bureau, told the Senate Space Committee last week that complex bills often require some perfecting amendments during the course of consideration by Congress. He added that both the Budget Bureau and the National Advisory Committee for Aeronautics are ready to help the committee clarify, explain or improve the text of the bill.

Under the proposed plan, NACA personnel, installations and research facilities would form the nucleus of the National Aeronautics and Space Agency.

Most military and Defense Department witnesses appearing before both committees expressed concern over the military role in the national space program and urged greater participation or complete control of space projects that have or may have military application.

"Almost without exception," Stans said, "testimony before the House and Senate committees has endorsed the principle of civilian control over those aspects of space science and exploration aimed at furthering the general knowledge of mankind. The President has recognized, and the bill reflects this awareness, that certain space programs should be conducted under the Defense Department because of their importance to the security of the nation. On this, there also seems to be no significant debate."

The issue, Stans said, is one of determining where the line should be drawn between space programs and projects appropriate for the civilian agency and those more suitable for administration by the Defense Department.

To resolve the question, Stans said the Administration would not object to the insertion of a clause that would spell out the Defense Department's complete responsibility for space activities peculiar to or primarily associated with weapon systems or military operations.

The budget director explained that there are projects that can be clearly defined as military and others as civilian but that a vast "gray area" exists where there is doubt as to whether an activity can be categorized as civil or military. In such cases, he said, it would be impossible to establish precise divisions of responsibility between agencies with closely related programs, especially when the future scope and dimensions of the program are so uncertain.

When questions arise over responsibility in gray-area projects, Stans said, assignment of responsibility will have to be determined by the normal processes of inter-agency cooperation. In some cases it will be necessary for the President, himself, to resolve such questions.

Dr. H. Guyford Stever, associate dean of engineering at Massachusetts Institute of Technology, and chairman of the NACA Space Technology Committee, said he felt the gray-area projects would be undertaken jointly between the civilian agency and the Defense Department.

G.M. Bids for Minuteman

Washington—General Motors Corp. is making a strong bid for the complete Minuteman multi-purpose ballistic missile project (AW March 17, p. 18). A special conference between G.M. division heads and senior officers of the Air Force Ballistic Missile Division on the subject was held May 7 at BMD's Inglewood, Calif., Headquarters.

This conference was arranged at Department of Defense level. General Motors presented the BMD officials a package plan whereby the managment design and manufacture of almost all Minuteman systems could be handled by the corporation with the Allison division having propulsion responsibility, AC Spark Plug building the guidance and much of the research and development being conducted in other G.M. facilities.

Following this presentation, Col. Ed Hall of BMD briefed the G.M. executives on the over-all Minuteman program. This was the first complete Minuteman briefing presented to any company. G.M. officials were assured by BMD that no decision would be made regarding any part of the Minuteman system until G.M. had prepared and submitted its detailed proposals.

General Motors personnel attending the conference included Cyrus R. Osborn, vice president and group executives, G.M. Corp.; S. E. Skinner, vice president and group executive, G.M. Corp.; J. A. Anderson, vice president and general manager, AC Spark Plug Division; E. B. Newill, vice president and general manager, Allison Division; Demitrius Gerdan, director, engineering, aircraft engine operations, Allison Division, and Dr. L. R. Hafstad, vice president, research staff, G.M. Technical Center.

Ballistic Missile Division officers attending included Maj. Gen. Bernard A. Schriever, BMD commander; Brig. Gen. Osmand J. Ritland, assistant deputy commander for ballistic missiles with additional duty as vice commander Ballistic Missile Division; Brig. Gen. Ben I. Funk, deputy director for ballistic missiles, Office of Director of Procurement and Production, Air Materiel Command; Col. William R. Large, Jr., assistant CINCSAC/SAC-MIKE (MIKE refers to the California area); Col. Samuel W. Bishop, chief of the Procurement Staff Division of AMC; Col. Sherman E. Ellis, chief of the Production Staff Division of AMC; Col. Edward N. Hall, director of Minuteman Project, BMD; Col. Albert A. Shumsky, chief of the Logistics Staff Division at AMC; Col. Charles H. Terhune, deputy commander of technical operations, BMD; Col. Otto Glasser, program director of the Atlas project; and, J. A. Clark, a civilan chief of production resources, AMC.

A number of companies have been actively participating in the Minuteman competition for several months. They include North American, Convair, Lockheed, Douglas, Martin, Ramo-Wooldridge, Thiokol, Aerojet-General and Phillips Petroleum.

Stever said that, in view of NACA's long record of cooperation with the military and other agencies, it is almost certain that the new agency and the Defense Department would conduct space exploration projects jointly and share responsibility with a minimum of conflict. Joint programs, he said, would give the military ample opportunity to explore areas of possible military value and, at the same time, allow the civilian agency to explore peaceful applications as well as aid the military in research.

Another provision of the bill which produced considerable conflicting testimony before both committees is whether administrative authority should be given to a single director, advised by a 17-man board as proposed or create a commission.

Stans strongly defended the director concept which he said the President considers vital to the operation of the new agency. He said this is the traditional way in which federal agencies charged with large operating programs are headed.

Stans, however, said he had no objection to changing the proposed organization from nine civilian and eight government members to nine government and eight civilians. The present plan was challenged earlier by Sen. Clinton P. Anderson (D.-N.M.) who said civilians, rather than the government, would control the agency.

Stans also said:

• **Wording could be changed to provide** that no less than three members of the 17-man committee would be from the Defense Department instead of one as called for in the proposed bill.

• **Administration would not object** to deleting a provision that would permit the agency to accept gifts or donation of services or money.

• **Paragraph could be inserted** calling for the agency to engage in a program of international cooperation in space exploration and for peaceful application of the results.

Dr. Hugh L. Dryden, NACA director, testified along similar lines and explained, in answer to the Senate Committee criticism, that the bill was purposely written in general, rather than specific terms, because the entire subject of space technology is and, for some time to come will remain, largely an assortment of unknowns.

Johnson and Anderson, as well as other members of the Senate committee, have been critical of the Administration for presenting proposed legislation that did not go into more detail clearly, or spell out provisions of the act.

Earlier, the Senate attack brought a sharp reply from Rep. Kenneth B. Keating (R.-N. Y.), a member of the House committee.

"Widespread misunderstanding is being fostered," he said, "by the inaccurate charges made against the administration's outer space bill. We cannot allow the American public to be misled in this important area of our national interest."

First Navy A3J Details

Columbus, Ohio—Navy's supersonic twin-jet A3J attack aircraft, which rolled out at North American Aviation, Inc., plant here last week, features high, thin swept wing and movable slab-type tail surfaces.

AJ3 has been fitted with folding wings and tail for carrier operations. Landing configuration incorporates droop leading edges and flaps and boundary layer control. Dimensions are: wing span, 50 ft.; over-all length, 70 ft. and height, 20 ft.

A3J will be lighter in weight than some of the attack planes now operating off carriers. Compressed nitrogen will be used to actuate wings flaps, air brakes and landing gear (AW July 8, 1957, p. 23).

Aircraft was to be christened by Adm. Arleigh A. Burke, Chief of Naval Operations, and J. H. Kindelberger, North American board chairman.

A3J is powered by two General Electric J79 jet engines, producing 15,000 lb. thrust each. Engine air inlets are of variable geometry design for optimum performance at all speeds. Aircraft is limited only by power, not by stability.

Industry Strike Tension Lessens

Los Angeles—Successful negotiations between unions and several Southern California aircraft and missile firms have lessened industry strike threat.

Lockheed and International Association of Machinists were first to reach a tentative agreement on a new two-year contract that calls for wage increases averaging nearly 21 cents per hour, retroactive pay at 16 cents an hour, cost of living increases, one additional paid holiday, automatic blanket pay increase next year of 3% or seven cents an hour —whichever is higher—and changes in seniority provisions and increased wage scales in 14 special new job classifications. Union members ratified Lockheed's offer. Negotiations are continuing between union representatives and Lockheed's Missile Division.

However, about 8,500 of the 13,000 workers at Lockheed's Marietta, Ga., facility are on strike, despite the West Coast settlement. Offer to IAM members there reportedly was identical to coast offer. Tentative agreement was reached last week, subject to ratification by the union's membership.

Union found unacceptable other provisions in the contract dealing with seniority, job security and what is termed the "agency shop."

Georgia has a "right to work" law preventing contracts with union or closed shop provisions, so instead a proposal called "agency shop," wherein an employe would have to pay union dues whether he actually belonged to union or not, has been substituted in negotiations. Lockheed is unwilling to agree to this provision.

In both Georgia and Missile Systems Divisions, unions wanted changes in seniority and job security clauses. Lockheed says contract at California Division specifies, and others would as well, that seniority within divisions will be protected against transfers which might occur as work within one division shows.

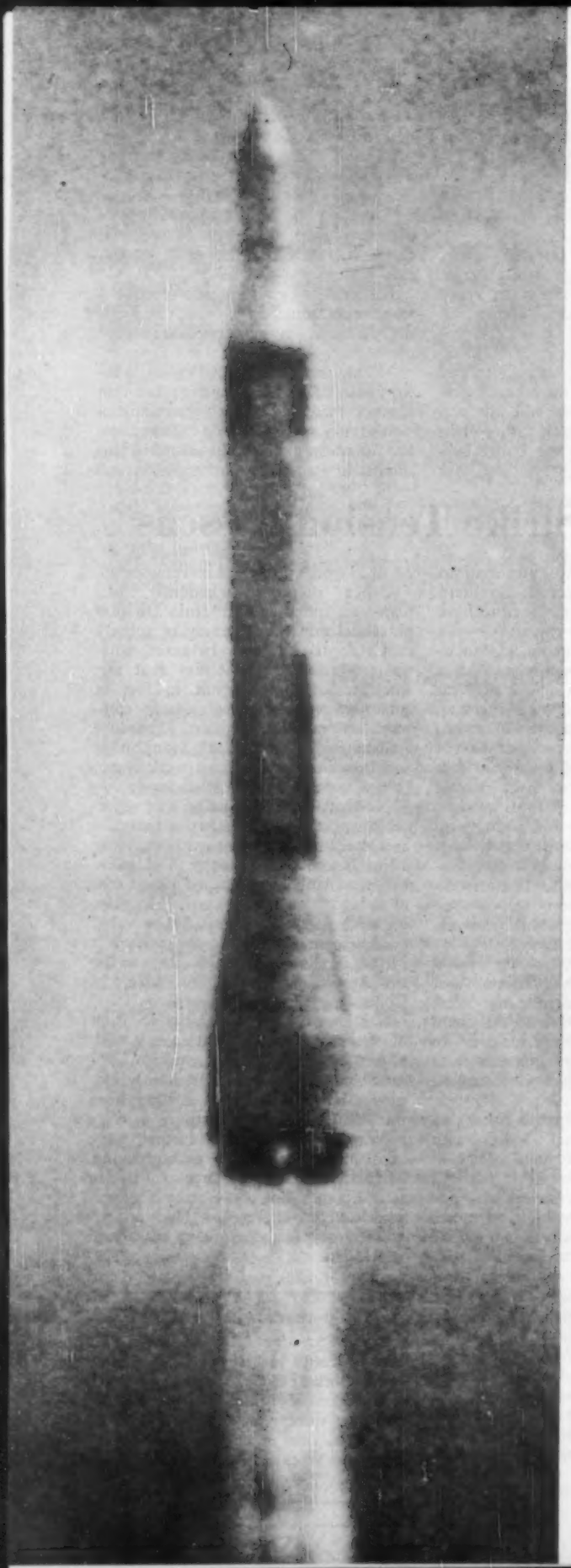
Other divisions apparently had feared an influx of California Division personnel due to slackening of activity at California Division. However, company says contract specifies that any interdivision moves result in loss of seniority, whether transfer is at company or employe request. Employe transferring to another division builds seniority from start of his work there, carries none from former division.

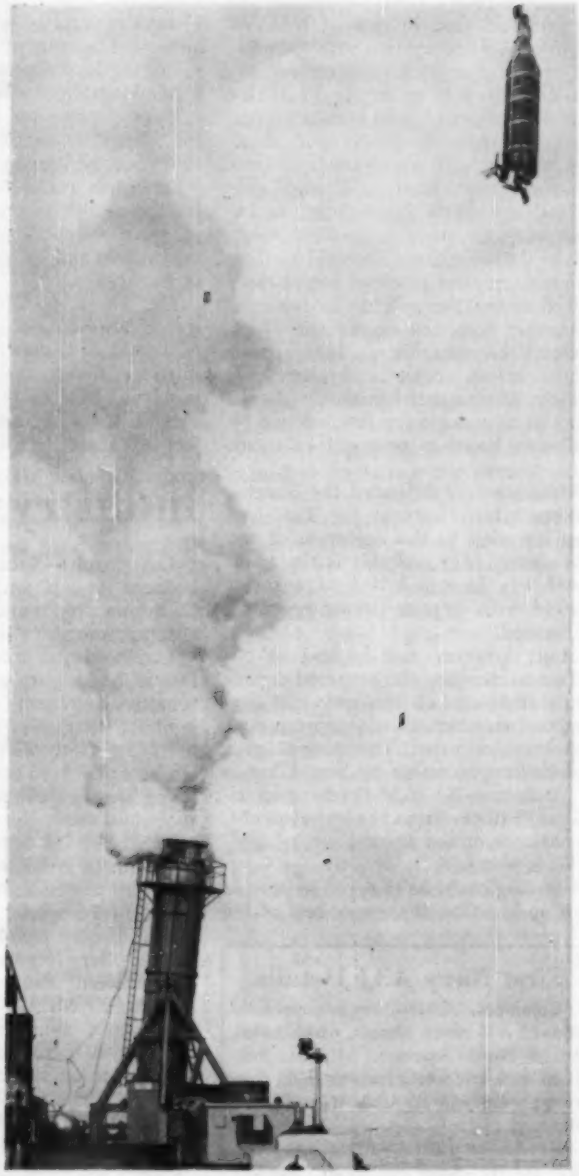
North American Aviation and representatives of UAW reached a tentative agreement on a two-year contract giving 17 to 26 cents an hour pay increase for this year which includes a 15 cent cost of living allowance, and a 3% increase for next year. Agreement, to be voted on by members, covers approximately 21,000 employes, 15,000 workers in the Los Angeles area and 5,500 workers in Columbus, Ohio.

San Diego and Astronautics Division of Convair effected settlement with unions based on wage increases to IAM members that would boost hourly employes from 17 to 27 cents an hour immediately, an automatic 3% wage increase next year and further wage adjustments for rises in cost of living. Members voted acceptance at the San Diego plants, but when same offer was presented to the Pomona Division, negotiations broke down and a walkout was called.

Correction

North American's Rocketdyne division has designed a package of three 2,500 lb. thrust rocket engines for the second stage propulsion of Krafft Ehricke's freight carrying space vehicle. Due to a typographical error in the May 12 issue of Aviation Week (p. 23), the engines were listed at 250,000 lb. thrust.





Polaris Test Vehicle Launched

Navy Polaris fleet ballistic missile test vehicle (left) is launched at Cape Canaveral, Fla. Missile exploded shortly after launching, but official statement said the breakup that occurred was expected. Four rocket nozzles protrude from flared tail. Above, a steel and concrete dummy of Polaris is successfully launched from a prototype launcher at San Francisco Naval Shipyard, Hunter's Point, Calif. (AW April 21, p. 31). Cable attached to dummy's nose runs out of launcher's mouth and communicates data from strain and pressure gages, accelerometers. Cable separates after launching and falls to earth; dummy falls into bay. Life preserver with coiled rope attached is fastened lightly to dummy's nose before launching; life preserver acts as marker buoy, facilitating recovery of submerged dummy. Testing is supervised by Westinghouse Electric Corp., developer of launcher, and Lockheed Missile Systems Division, Polaris system manager.

House Foresees Curb In Defense Changes

Washington—House is expected to squeeze out the "vague," sweeping provisions in the President's plan for reorganization of the Defense Department and pass legislation within a week or two authorizing the few specific changes proposed.

Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee, cynically commented that these "can be written on the back of an envelope."

During three weeks of hearings, committee Democrats were critical at what they termed the wide discrepancy between what the administration "could" do under the President's plan (AW Apr. 14, p. 28) and what administration witnesses testified it was actually intended to do.

The committee started re-drafting last week.

Armed Services Democrats also insistently pointed out that the basic idea of the President's plan—centralized control of Department of Defense by the Secretary of Defense—represents a complete switch from his 1953 position when he reorganized the Department to achieve greater decentralization of administration.

A Democratic view was expressed by Rep. Mel Price (D.-Ill.), a member of Armed Services, who said: "I am in favor of giving the President and administration everything they really want —although exactly what they do want is vague and changing. Then there can be no more alibis and no room for excuses over the bumbling defense program."

The main points of change proposed in the reorganization legislation are:

• **Command channels:** The legislation would remove the service secretaries from the line of command from the Secretary of Defense and the Joint Chiefs of Staff to unified commands. Vinson points out that it was the President himself who established service secretaries as the executive agents to administer unified commands in 1953.

• **Service autonomy:** Provisions of the 1947 Unification Act qualifying that the three services shall be "separately administered" would be eliminated. Vinson maintains that this act clearly establishes the Secretary of Defense as "the boss" over the services. He notes that it was the President who effected a decentralized operation. The President said in his 1953 report to the Congress: "In an organization the size of the Department of Defense, true effectiveness with economy can be attained only by decentralization of operations under flexible and effective direction and control from the center. . . ."

• **Joint Chiefs of Staff:** The chiefs would be removed from service duties and responsibilities and expand the JCS operating staff. There appears to be little opposition in Armed Services Committee to permitting the Chiefs of Staff to delegate duties to the Vice Chiefs of Staff.

There is considerable opposition, however, to the delegation of "responsibility" since this might lead to a system under which the Joint Chiefs planned but had no responsibility for the execution of their plans. The committee, as well, is also expected to set a legal limitation on the size of the JCS operating staff.

• **Combatant functions:** Secretary of Defense would be given greater flexibility in assigning service functions. Defense Secretary Neil McElroy testified that there was no intention of making such sweeping changes as the abolition of the Marine Corps or naval aviation. The Armed Services committee will probably spell this out.

Navy Plant Produces Boron-Based Fuels

Model City, N. Y.—First full scale plant for the production of high energy, boron-based fuels has gone into operation in this city, 17 mi. north of Niagara Falls.

New plant, built and operated by Olin Mathieson Chemical Corp. for the Navy, is making a liquid alkyl borane called HEF-2 that is expected to be used in the afterburners of future jet aircraft such as the B-70 bomber. Dr. L. Kermit Herndon, Olin Mathieson vice president, said that the company also is working on development of a solid, borane rocket fuel.

Built at a cost of $4½ million, the new plant officially belongs to the Navy but will supply fuel to the Air Force as well. Sometime next year, Olin Mathieson expects to complete the $45 million Air Force fuel plant which is now being built adjacent to the Navy facility here. HEF-3, reported to be ethyl alkylated decaborane, will be produced in the Air Force plant. At present, still another liquid borane fuel, HEF-4, is being made on a pilot plant basis.

Olin Mathieson high energy fuel program nearly parallels that of Callery Chemical Co.; both programs are an outgrowth of the Zip project initiated by the Navy in 1952 and joined by the Air Force in 1955. Callery recently completed the third unit of its own liquid borane plant in Lawrence, Kan.; hopes to have the fourth and final unit finished and the plant onstream in June, at which time it will start fuel shipments to the Navy. The company is building a second and larger plant for the Navy. And Callery, like Olin Mathieson, also is working on the development of a solid, borane rocket fuel. Callery calls its borane fuels, Hiccal.

Boron-based fuels can increase the range, speed and/or payload of aircraft and missiles because of their high heating values. Compared to an average heating value of 18,600 Btu./lb. for jet and rocket hydrocarbon fuels such as JP-4 and RP-1, a liquid alkyl borane releases 25,000 Btu./lb. while the solid decaborane produces about 28,000 Btu/lb.

New Soviet Sputnik Orbits

Moscow—Soviet Union last week successfully launched Sputnik III weighing close to 3,000 lb., equipped with solar batteries in addition to electro-chemical sources of power.

The Sputnik was described as a cone-shaped device 11 ft. 8 inches long and 5 ft. 8 inches wide at the base. Russians claimed the satellite weighs 2,972 lb.

Following the launching, the satellite reached an orbit of 65 deg. in the equatorial plane with an apogee of 1,167 mi. It was circling the earth every 106 minutes. The fourth stage of the launching rocket is following the satellite in a close orbit.

Russians said that no living animal was contained in the satellite.

The official Soviet announcement said the scientific and radio equipment installed in the Sputnik was controlled by a "programming device." It added: "The temperature regime essential for the normal working of the satellite's equipment is ensured by a system of thermal controls which alter, with the aid of special devices, the coefficients of radiation and reflection of the surfaces."

Here are some of the research projects the Russians plan to conduct through the equipment contained in the Sputnik:

• Pressure and composition of the atmosphere in the upper layers and concentration of positive ions.

• Magnitude of electrical charges in the satellite and the intensity of the earth's electrical statistical field.

• Intensity of the earth's magnetic field and intensity of the sun's corpuscular radiation.

• Composition and variations of the primary cosmic radiation and distribution of photons and heavy nuclei in cosmic rays.

• Micrometers and temperature inside and outside the satellite's surface.

Sputnik II photos above were taken at 308 sec., 320 sec. and 322 sec. after 1800 EST Dec. 21 by telescope at Patrick AFB, Fla.

Photos above were taken at 328 sec., 336 sec. and 340 sec. Sequence shows clockwise tumbling motion of Soviet satellite.

Sequence above was taken at 342 sec., 348 sec. and 356 sec. Analysis of photos indicates rocket is approximately 79 ft. long.

ROTI Photos Indicate Tumbling Sputnik II's Size

Photo sequence of Soviet Sputnik II satellite was taken by Perkin-Elmer ROTI optical tracking telescope at Air Force Missile Test Center, Patrick AFB, Fla., when rocket passed within 200 stat. mi. of AFMTC. Tracking telescope has 24 in. aperture and focal length up to 500 in. (AW Oct. 28, p. 110). Maximum focal length was used for these photos. Analysis of photos made by Radio Corp. of America Service Co. concluded that total length of the rocket is between 74 and 84 ft. or, putting it another way, 79 ft. with an uncertainty of about 5 ft. Diameter is almost impossible to determine because of the mirror-like reflecting surface of the metal skin. Intense highlights on left end of rocket appear to be caused by reflections from single control vane which begins near midsection of rocket and extends rearward. Intense reflections on right end of rocket are believed to be caused by dog capsule. Clockwise (looking at photos) tumbling motion of satellite rocket is indicated by photo sequence. Analysis indicates that at time these photos were taken, satellite was tumbling end over end once in 200 sec. Due to great distance of rocket from camera (200 mi.), structural details other than length are almost impossible to discern. Photo enlargements shown are typical frames from the best or middle part of a series and represent intervals of 2 sec. of time. Photos are magnified 27.7 times from the original film. Magnification was determined from similarly enlarged photos of the sprocket holes of the film and their known dimensions and spacing. To determine true length of the rocket it is necessary to know the orientation in space of the rocket axis relative to the observing telescope. Simultaneous coverage was obtained with another telescope with 24 in. aperture and 240 in. focal length located about 14 mi. from ROTI. This permitted determination of rocket's orientation. The second, smaller telescope took photos which duplicated exactly (but at half-scale due to shorter focal length) the appearance of images on ROTI film. ROTI (recording optical tracking instrument) consists of a primary objective telescope, sighting telescopes, highspeed 70 mm. camera, controls and associated equipment. Eight-ton system is assembled on a Navy 5-in. gun mount.

Snyder Reports Plans to Merge Service Public Information Offices

By Katherine Johnsen

Washington—Plans to consolidate the information and security review activities of the three military services with the Office of the Secretary of Defense were disclosed to House Armed Services Committee by Murray Snyder, the Assistant Secretary for Public Affairs.

Rep. John Moss (D.-Calif.), chairman of the House Information Subcommittee, promptly announced that he would attempt to block the plan, charging that it was "a grab for power" by Snyder who wanted "absolute control" in order to manipulate the release of news for policy reasons.

"It means less and less information will be available to the people and Congress," he declared. "It means intimidation of anyone who might have any independence." The first step of Moss's subcommittee was to request detailed reports from Secretary of Defense Neil McElroy and the information chiefs of the services.

Snyder told the House Armed Services Committee that he had discussed the consolidation plan with the information chiefs of the services and anticipated no objections from them on "the diminution of their authority" which it would entail. The service information chiefs, he said, would become "advisers" in his office.

"The chiefs of information who have consulted with me indicate that they are willing to give it all they have and support this plan as we have begun to outline it," Snyder reported.

Information officials of two services, however, told AVIATION WEEK that their first information on the consolidation was from press reports on Snyder's testimony before the House committee. They indicated unalterable opposition to it.

Personnel Survey

Snyder's office is now making "a detailed man-by-man study of the personnel" in the four service information offices. "The objective," Snyder said, "is to bring into our combined operation the very best people they have."

Branch information offices at New York and Los Angeles, now manned by personnel of the individual services, Snyder reported, will be operated as "adjuncts" of his office "if they are continued at all."

Service personnel would staff the information offices at individual service installations outside Washington under "guidance" from Snyder's office. The efficiency rating given by Snyder would have equal weight with the rating given by commanding officer of the installation.

Appointments for press interviews with service officers or officials would be arranged through Snyder's office, instead of through the service information office.

Snyder commented that the service information chiefs are "fine men" and "I have the highest respect for them as military officers whose zeal and loyalty to their services is of a very high degree." He added:

'Loose Confederation'

"They are operating now in a more or less loose confederation and with a great deal of autonomy, particularly since they have these large staffs which do their planning. . . . They do their unilateral planning for news developments and for relationships with public organizations and for participation in public events around the country and at the seat of government.

"The principal advantage (of the consolidation) will be in the joint planning which we envisage by the establishment of a planning office in the Office of Public Affairs."

Asked whether censorship is imposed for policy reasons, Snyder said:

"You may call it censorship. It is review for conflict . . . for conflict with established policies or programs of the Department of Defense or of the national government."

In the missile field, he added that "the Department of Defense has a responsibility to determine that announcements do not give an impression which may be misleading to the public concerning the availability or the nearness to operational capability. . . . We must see that the news is not ahead of the production lines."

Obligation Lag

Washington—Obligations for new procurement contracts for aircraft and related materiel are lagging behind last year. Department of Defense reports that total obligations for Air Force and Navy procurements were $7.1 billion for the first nine months of Fiscal 1958 (July through March) as compared with $7.8 billion for the same Fiscal 1957 period.

Air Force procurements were $5.5 billion for the Fiscal 1958 period as compared with $6.1 billion for the 1957 period; Navy procurements were $1.6 billion as compared with $1.7 billion for the 1957 period.

Expenditures for aircraft and related procurement were up: $7.5 billion for the first nine months of Fiscal 1958 as compared with $6.8 billion for the first nine months of Fiscal 1957.

As of April, USAF and Navy had a total unexpended balance for aircraft and related purchases of $16.5 billion. The unobligated balance on hand for new contracts totaled $7.6 billion.

British Investigate Third Viscount Crash

London—British government is investigating the third crash within seven months of a British European Airways Viscount 800. Aircraft hit the ground several miles short of the runway at Prestwick Airport.

Officials said the BEA Viscount, which was on a ground controlled radar approach, hit in a normal flight attitude with wheels up. No passengers were aboard. Aircraft was on charter to British Overseas Airways Corp. and was to pick up transatlantic passengers at Prestwick. Crew of five escaped with injuries. Weather at the time of the crash was above minimums, but with a 300 ft. ceiling, according to a government spokesman.

Meanwhile, Danish government report is expected next week on Nov. 17 crash of BEA Viscount 802 near Copenhagen. Crew of two escaped unhurt when airplane made a forced landing on night flight from London.

British authorities are continuing investigation of October crash of Viscount 802 which was destroyed at Nutts Corner Airport near Belfast, Ireland. Aircraft was making a GCA go-around when it hit the ground. Seven BEA crew members were killed.

Coast Guard Orders C-130Bs for Rescues

Coast Guard will fly Lockheed C-130B Hercules on air-sea rescue missions. First two aircraft are slated for delivery in late 1959 from Lockheed's Georgia plant. Order is addition to Air Force contract for 53 C-130Bs. Congress has approved Fiscal 1959 appropriation for two more Coast Guard C-130Bs to be delivered in 1960. Coast Guard plans call for total complement of 14 C-130Bs.

Modifications necessary to convert C-130B to search and rescue aircraft include re-arrangement of cockpit in order to add radio operator's station and accommodations for an on-the-scene commander. Two seats at rear paratrooper doors and clear visions panels will provide scanning posts for observers during air-sea rescue missions.

First Quarter Shows Increases; Aviation Resists Recession Drop

New York—First quarter earnings in the aviation industry generally bucked the downtrend in other industries. Boeing, Cessna, General Dynamics, Lockheed, McDonnell, Temco and United Aircraft reported increased earnings; Martin, North American and Curtiss Wright were down.

United Aircraft, whose earnings last year reached an all-time peak, reported first quarter 1958 earnings of $11,543,-934. Earnings last year in the same period were $10,967,663.

Sales rose from $297,993,962 to $308,847,101 and per share earnings from $1.69 to $1.78. Backlog was $1.8 billion.

Boeing's earnings rose to $9,499,190 compared with $8,075,464 a year ago. Sales of $411,051,648 compared with $292,711,969 a year ago represented a net return of 2.31 cents per dollar of sales and emphasized a trend toward rising volume and smaller profits in the industry.

Write-offs on the 707 jet transport, rising interest expenses and increased amortization on facilities bore substantial impact on profit margin, Boeing said.

Lockheed Aircraft Corp.'s first quarter earnings increased almost 50% despite earlier predictions by the company that 1958 would not be as good a year as 1957. The figures:

	1958	1957
Earnings	$5,076,000	$3,415,000
Per share	$1.72	$1.16
Sales	$238,670,000	$195,479,000
Backlog	$1,251,523,000	$1,533,469,000

Board Chairman Robert Gross repeated the earlier note of caution, forecasting that sales and earnings might be lower for the remainder of the year. However, totals for the year should be satisfactory, he said.

Development write-offs for the Electra turboprop transport were 20% less than the same period last year, explaining to some extent the earnings increase this year.

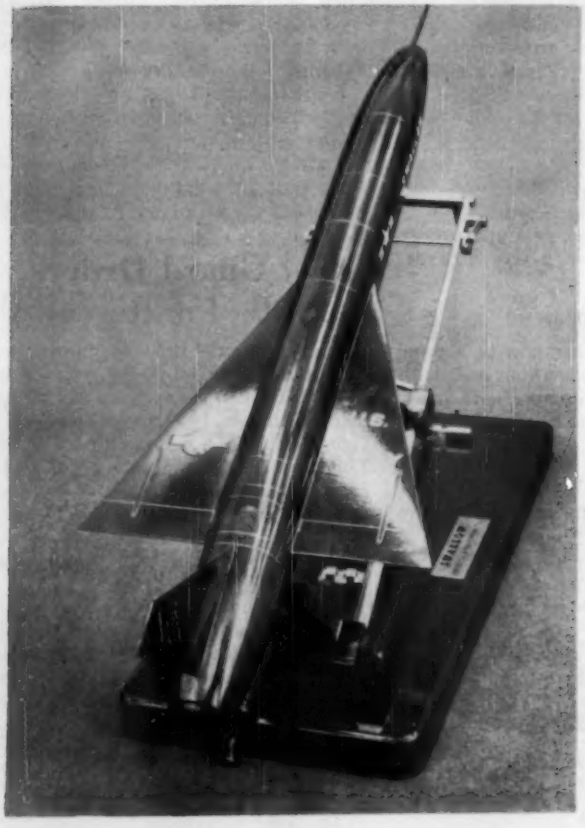
• **Curtiss Wright** net dropped from $9,942,256 last year to $5,014,560 this year, or from $1.26 to 62 cents a share. Sales also fell, from $147,427,760 last year to $105,076,814 this year. A $15 million increase in backlog was reported by the company, however, bringing total to $330,000,000.

• **General Dynamics'** earnings rose from $9,399,611 to $9,872,366 and sales from $342,758,297 to $386,419,273. Per share earnings were $1.01 this year compared with $1.05 last year, but the recall of a debenture issue resulted in there being about 800,000 more shares of common outstanding this year. Backlog was $1,774,000,000 at the end of the quarter.

• **McDonnell Aircraft Corp.** earnings after taxes were $6,681,299 on sales of $321,993,672 for nine month period ending March 31. Earnings topped a similar period in 1957 by $469,147. Company's backlog of orders is $487,-055,727, which does not include a recent F-101B contract for $58,140,000. McDonnell employs 24,822 persons.

• **Temco Aircraft Corp.** reported first quarter net earnings of $596,957, against $294,798 for the first three months of 1957. Quarter sales were $27,145,000, compared with $27,227,000 a year ago. Temco has a backlog of about $135,-000,000 and is continuing development of Navy's Corvus missile.

• **Cessna Aircraft Co.**, Wichita, Kan., reports second quarter earnings reached an all-time high with profits after taxes amounting to $1,585,719, or $2.07 a share, compared with $1.12 a share for a similar period last year. Earnings for first six months totaled $2,068,609, against $1,694,138 a year ago. Sales for three month period ending March 31 were $23,656,000, a gain of $6,422,-



Republic Develops Jet Drone

Swallow, delta-wing turbojet-powered drone, is being developed by Republic Aviation Corp.'s Guided Missile Division for Army. All-weather advance surveillance drone, which will be able to carry television, infrared or photographic equipment, is shown in model form. Short range of drone could be increased. Swallow uses zero-length launcher with JATO assist. Contract for Swallow is valued at $3 million and includes study, development and detail design and production of service test models. Phase I study has been completed.

000 over the previous year. Six-month sales totaled $44,428,000, or 37% more than for the same period last year. Company directors declared a dividend of 40 cents a share payable to stockholders of record May 9. Company's military backlog on Boeing B-52 stabilizer assemblies and T-37A twin-jet trainer exceeds $52,000,000.

• **The Martin Co.** reported first quarter income of $1,693,531, a drop of $316,004 under that period a year ago. Quarter sales were $96,361,490, against $98,748,234 in 1957.

• **North American Aviation, Inc.** backlog of orders totaled $515,750,306 as of March 31. Company reported its net income for six month period ended March 31 was $12,881,000, compared with net income of $18,482,000 for that period in 1957.

Piper Aircraft said gross sales for the first six months of its fiscal year were $12,486,217, a drop of $1,969,599 under a similar period last year. Net income was $975,216, against $1,592,109 a year ago.

Officials looked for increased earnings, noting that Piper Comanche production will reach four airplanes a day in September and is scheduled for five a day in October.

Other financial reports revealed:

• **Fairchild Camera and Instrument Corp.** lost $209,000 in the first quarter compared with a $32,000 loss last year. Sales were $7,210,000 this year and $9,624,000 last year. The company said it expected to show a profit by the end of the year and added that it had just received a substantial contract for Jupiter C test equipment.

• **Food Machinery and Chemical Corp.** which makes ground handling equipment for Thor and other missiles, reported gross income from defense sales of $50,782,544 for 1957, a $2.5 million drop from 1956. Total earnings for 1957 were $15,895,406 and earnings per share were $4.60.

• **Jack & Heintz** report first quarter net income of $346,000 or 38 cents a share on sales of $6,098,000 compared with last year's income of $388,000, or 42 cents a share, on sales of $6,454,000.

• **Aeronca Mfg. Corp.** diversifying into high temperature aircraft structures and commercial products, reported sales increased in 1957 by $2.5 million to a total of $22,729,999. But for cutbacks last year, sales would have been higher, the company noted. Earnings rose to $601,507 or 95 cents a share compared with $512,417 in 1956, equal to 77 cents a share.

• **Texas Instruments** reported a record first quarter, with sales of $20,480,000 and earnings of $1,109,000 or 34 cents a share. Last year sales and earnings were $15,252,000 and $790,000.

• **Air Reduction Co.** sales and earnings dropped under 1957 levels, with company reporting 1958 net income of $3,370,716, a 22% drop under a year ago. First quarter sales totaled $46,243,507, a drop of 6.5%.

• **American Bosch Arma Corp.** quarterly profits were $886,708 on sales of $27,018,890. Profits dropped $454,907 under last year when sales were $31,380,571. Company backlog of military orders was estimated at $165,000,000.

• **Aeroquip Corp.** reported quarterly earnings of $387,186, an increase of $123,095 over the same period a year ago. Six-month sales totaled $17,120,431, as against $20,928,660 last year. Quarterly sales were $8,294,036, compared with $8,826,395 in 1957.

• **All American Engineering Co.,** holding a backlog of $3,200,000, reported 1957 earnings of $50,595 on sales of $4,091,733.

• **Rheem Manufacturing Co.** said it lost $170,288 in the first quarter. Sales were dropped to $37,420,014 from $48,195,180 in 1957.

Aircraft Companies File Reports On Executive Pay, Stock Holdings

Washington—Following is a list of executive and directors salaries and stock holdings as filed by aircraft companies with the Securities and Exchange Commission:

LITTON INDUSTRIES INC.—**C. B. Thornton,** president and chairman, board of directors, $52,000 salary and 157,999 shares of common stock; **R. L. Ash,** vice president and director, salary not listed, 67,981 shares of common stock; **H. W. Jamieson,** vice president and director, salary not listed, 67,756 shares of common stock; **M. L. Mace,** vice president and director, salary not listed, 16,756 shares of common stock; **G. McDaniel,** vice president and director, salary not listed, 5,000 shares of common stock; **C. A. Spaatz,** director, 2,800 shares of common stock; **J. A. Thomas,** director, 26,495 shares of common stock.

PIASECKI AIRCRAFT CORP. The corporation did not report salaries of its officers or directors: **F. N. Piasecki,** president and chairman, board of directors, 198,055 shares of common stock; **D. N. Meyers,** vice president and director, 43,267 shares of common stock; **J. J. Davis,** secretary and director, 1,000 shares of common stock; **R. G. Kutzer,** assistant treasurer and director, 100 shares of common stock; **E. G. Vanderlip,** director, 1,050; **E. Deland,** engineering consultant and director, 43,268 shares of common stock; **R. Deetjen,** director, 500 shares of common stock; **G. J. Higgens,** director, 450 shares of common stock; **D. Lillis,** director, 625 shares of common stock.

THE GARRETT CORP. Figures are for the fiscal year ending June 30: **J. C. Garrett,** chairman, board of directors, $82,069 salary and 22,356 shares of common stock; **M. S. Gelber,** vice president, secretary and director, $40,191 salary and no stock listed; **W. D. Morgan,** vice president and director, $58,610 salary and 5,286 shares of common stock; **W. R. Ramsaur,** vice president and director, $62,519 salary and 5,534 shares of common stock; **B. N. Snow,** vice president and director, $42,981 salary and 1,000 shares of common stock; **W. C. Whitehead,** president and director, $76,974 salary and 6,605 shares of common stock; **E. Barlow,** vice president and director, salary not listed, 14,332 shares of common stock.

E. A. Bellande, vice president and director, salary not listed, 261 shares of common stock; **L. T. Chou,** director, no salary or stock; **C. T. Leigh,** no salary, 145 shares of common stock; **W. R. Lovelace II,** director, no salary or stock; **V. N. Rossetti,** director, no salary, 145 shares of common stock; **Merrill, Lynch, Pierce, Fenner and Smith,** stockholder, 121,856 shares of common stock.

WESTINGHOUSE ELECTRIC CORP.—**G. A. Price,** chairman, board of directors, $138,779 salary, 6,116 shares of common stock; **M. W. Cresap,** president and director, $109,979 salary and 1,627 shares of common stock; **E. V. Huggins,** chairman, executive committee, vice president and director, $53,239 salary and 2,054 shares of common stock; **J. E. Hodnette,** executive vice president and director, $97,767 salary and 2,463 shares of common stock.

The following persons did not receive salaries: **E. Hopkinson Jr.,** director, 200 shares of common stock; **J. W. Beavis,** director, 200 shares of common stock; **J. M. Schiff,** director, 12,500 shares of common stock; **D. Anderson,** director, 200 shares of common stock; **A. W. Page,** director, 260 shares of common stock; **W. C. Robinson,** director, 1,000 shares of common stock; **R. H. Taylor,** director, 400 shares of common stock.

E. O. Boshell, director, 400 shares of common stock; **H. B. Higgens,** director, 400 shares of common stock; **C. R. Cook,** director, 100 shares of common stock; **W. A. Patterson,** director, 100 shares of common stock; **A. W. Robertson,** director, 1,000 shares of common stock; **F. R. Denton,** director, 100 shares of common stock; **J. L. Hall,** director, 705 shares of common stock; **T. J. Hargrave,** director, 100 shares of common stock; **J. J. McCloy,** director, 100 shares of common stock.

THE MARTIN CO—**G. M. Bunker,** president and chairman, board of directors, $140,000 salary and 77,344 shares of common stock; **W. B. Bergen,** executive vice president, $64,000 salary with stock not listed; **J. W. Sweetser,** vice president, $49,000 salary with stock not listed; **G. T. Willey,** vice president, $49,000 salary with stock not listed; **H. Bruce,** director, no salary and 4,730 shares of common stock; **W. A. Burns Jr.,** director, no salary and 200 shares of common stock; **J. E. Parker,** director, no salary and 2,000 shares of stock; **E. H. Pixley,** director, no salary and 122 shares of common stock; **A. R. Royce,** director, no salary and 242 shares of common stock; **F. F. Russell,** director, no salary with 37,500 common shares of common stock owned by National Aviation Co. of which Russell is a director and chairman of the executive committee; **D. M. Spencer,** director, no salary and 1,103 shares of common stock; **J. L. Sullivan,** director, no salary and 9,702 shares of common stock.

HILLER HELICOPTERS—The following officers and directors were not listed in the salary columns on S.E.C. proxy statements: **S. Hiller Jr.,** president and director, 100,000 shares of common stock; **W. A. Blees,** director, no stock; **E. T. Bolton,** executive vice president, general manager and director, 200 shares of common stock; **F. A. Callery,** director, 1,000 shares of common stock; **A. J. M. Chadwick,** senior vice president and director, 500 shares of common stock; **K. Ferguson,** director, 500 shares of common stock; **P. M. Hamilton,** director, 100 shares of common stock; **F. A. Heilman,** director, no stock; **S. Hiller Sr.,** director, 3,250 shares of common stock; **M. E. McAlpin,** director, 1,900 shares of common stock; **H. L. McIntyre,** director, 50 shares of common stock; **L. B. Richardson,** director, 100 shares of common stock; **A. W. B. Vincent,** vice president and director, 13,503 shares of common stock.

AERONCA MANUFACTURING CORP.—

J. A. Lawler, president and director $60,000 salary and 52,000 shares of common stock; **S. H. Badgett**, vice president-operations, $35,000 salary and no stock listed; **R. E. Harrison**, director, no salary with 1,825 common shares and 625 prior preferred shares of stock; **F. L. Roberts**, director, no salary and 300 shares of common stock; **E. Streifhare**, director, no salary with 10 common shares and 250 prior preferred shares of stock.

G. J. Wolf, director, no salary with 5,325 common shares and 650 prior preferred shares of stock; **R. A. Dadisman**, director, no salary and 500 shares of common stock; **F. D. Danford**, director, no salary and 11,950 shares of common stock; **L. T. Kemmey**, director, no salary with 100 common shares and 140 55-cent cumulative preferred shares of stock; **S. J. Kuderer**, secretary-treasurer and director, salary not listed with 1,300 shares of common stock; **E. S. Myers**, director, no salary with 250 common shares and 1,300 shares of prior preferred stock; **J. Slezak**, director, no salary and 100 shares of common stock.

PIPER AIRCRAFT CORP.—**W. T. Piper**, president and chairman, board of directors, $38,782.80 salary and 139,144 shares of common stock; **N. J. Green**, director, no salary and 9,185 shares of common stock; **R. K. Griffin**, director, no salary and 578 shares of common stock; **E. N. Hunting**, director, no salary and 1,050 shares of common stock; **W. J. Jamouneau**, secretary, chief engineer and director, salary not listed with 315 shares of common stock; **H. Piper**, vice president-research and development and director, salary not listed with 23,108 shares of common stock.

T. F. Piper, vice president-operations and director, salary not listed with 21,409 shares of common stock; **W. T. Piper Jr.**, executive vice president, salary not listed with 21,953 shares of common stock; **C. W. Pool**, treasurer and director, salary not listed with 577 shares of common stock.

BENDIX AVIATION CORP.—**M. P. Ferguson**, president and director, $150,599.96 salary and 3,073 shares of common stock; **W. H. Houghton**, vice president, treasurer and director, $82,850 salary and 3,038 shares of common stock; **R. P. Lansing**, vice president and director, $87,650 salary and 3,748 shares of common stock; **C. Marcus**, vice president and director, $94,650 salary and 225 shares of common stock; **G. E. Stoll**, vice president and director, $82,100.04 salary and 1,552 shares of common stock; **H. B. Baker**, director, no salary and 2,247 shares of common stock; **J. D. Biggers**, director, no salary and 225 shares of common stock; **C. Francis**, director, no salary and 210 shares of common stock; **E. Kanzler**, director, no salary and 1,124 shares of common stock; **C. S. H. Mott**, director, no salary with C. S. Mott Foundation holding 22,470 common shares and the Mott family group holding 32,822 common shares of stock; **E. R. Palmer**, director, no salary and 898 shares of common stock; **L. F. Polk**, vice president, group executive, member of the executive committee and director, no salary and 76,914 shares.

Supersonic Bomber Cancellation Sparks RAF Air Chiefs 'Revolt'

London—Military discontent with government defense economies broke into the open in Britain this week, spurred by release of details of an unconventional supersonic bomber which has been cancelled in the cutback.

Several British newspapers gave prominent play to what they called the "revolt of the air chiefs." These stories stemmed from an air conference in London during which Royal Air Force spokesmen, including Chief of Air Staff Sir Dermot Boyle, outlined future RAF requirements, with a strong emphasis on supersonic manned aircraft.

Many took this to be an open declaration of war with the White Paper philosophy of Defense Minister Duncan Sandys, who advocates as swift a transition as possible to guided weapons.

Fuel was added to the fire with release of details of a projected 1,800-mph. folding wing bomber labeled the Swallow. Government support of the Vickers-Armstrongs design has been dropped after a large research contract expenditure, estimated by one paper to be as high as $4.2 million.

These details of the Swallow were given:

• **Its wings**, straight for landing and takeoff, could be swept in flight for achievement of speeds of Mach 2.5.

• **Powerplants** were to be four wingtip-mounted jet engines which could be swiveled in flight for control purposes. There were no ailerons, flaps or tailplane called for in the design.

• **Revolutionary cooling** system was designed to hold down skin temperature rise at high speeds. No further details of this were available.

Defense Ministry sources say there is U. S. and NATO interest in the British design but there will be no further United Kingdom backing for it. Director of the project was Dr. Barnes Wallis, chief of research and development at Vickers-Armstrongs (Aircraft) Ltd.

What the RAF chiefs said at the controversial London conference did not, in fact, conflict with the Sandys White Paper, which called for continued development of the supersonic English Electric P.1 fighter and a successor to the Canberra bomber.

But their references to a supersonic bomber were, in many quarters, taken as a demand for reinstatement of the cancelled Avro program for a V-bomber successor rather than as a reference to a follow-up Canberra design.

Speakers, discussing RAF long-range plans, emphasized that while missiles will have a larger role, manned aircraft will continue to have major importance and will never be abandoned entirely.

"The unmanned weapon, compared with the manned weapon, is very inflexible, and in war you need flexibility." Sir Dermot said.

Chief among the prospects mentioned for manned aircraft:

• **Second generation** of V-class bombers, plus the Canberra bomber replacement. Designs for the latter class bombers exist, and "all we need now is the all-clear to go ahead and develop it."

• **A long-range fighter** designed to intercept, identify and destroy beyond the practical range of surface-to-air guided weapons. A simpler, more versatile and economic aircraft than current interceptors will be needed for overseas policing.

• **Comets and Britannias** will suffice for personnel carrying, but a long-range freighter will be needed, and a decision on this probably will be made soon. There also may be development of a short range freighter smaller than the Blackburn Beverley—possibly with vertical take-off.

• **Work is progressing** on the Bristol 192 general purpose helicopter, and a decision will be made between several new types under development to replace the Whirlwinds and Sycamores.

Speakers were less specific about missile development. Main points were:

• **There will be a second** generation of unmanned weapons currently under development.

• **Surface-to-air Bristol-Ferranti** Bloodhounds will be followed by a further development of the English Electric Thunderbird, for defense against higher-flying supersonic bombers. Both will be converted to carry nuclear warheads.

News of the Swallow bomber added to the belief that the air chiefs were up in arms over the supersonic bomber cancellations.

It was the propriety of holding a conference open to misinterpretation—if, in fact, it was misinterpretation—which drew Defense Ministry fire rather than any actual statements made at the conference.

No time was wasted in calling Chief of Air Staff Boyle on the carpet for this matter.

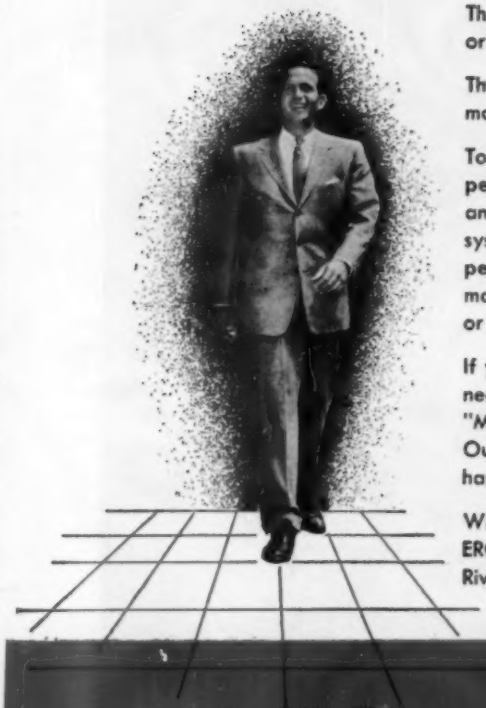
The fact that the conference was attended by such high ranking personalities as the Duke of Edinburgh and Chief of Naval Staff Lord Mountbatten added to the importance of the views presented there.

Opposition members in Parliament had a field day with the situation. Labor Party spokesman George Brown said the presentation of the RAF's role "could bear the interpretation that this was simply an American-style conference where one service quite openly and bluntly projects its claims, both against other services—in this case the Navy—and also against the Ministry of Defense which exists allegedly to coordinate defense. It could bear that interpretation, and to that extent, the conference was not only questionable but improper."

Publicly, at least, the Defense Ministry prefers the explanation that the Royal Air Force did not realize the political implications of what it was doing. Even if this is true, it does not conceal the fact that a conflict does exist.

RAF leaders, as well as spokesmen

guidance system experts through ERCO training devices



The guidance system of a missile is critical to its purpose—without the system—or without intelligent handling of the system's equipment there is no effective weapon.

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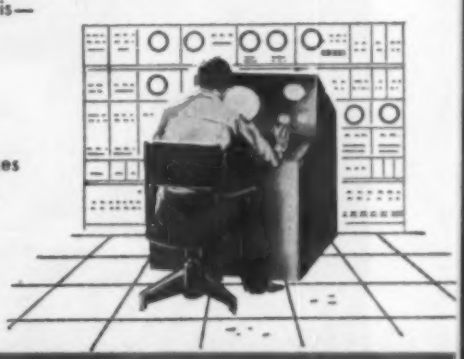

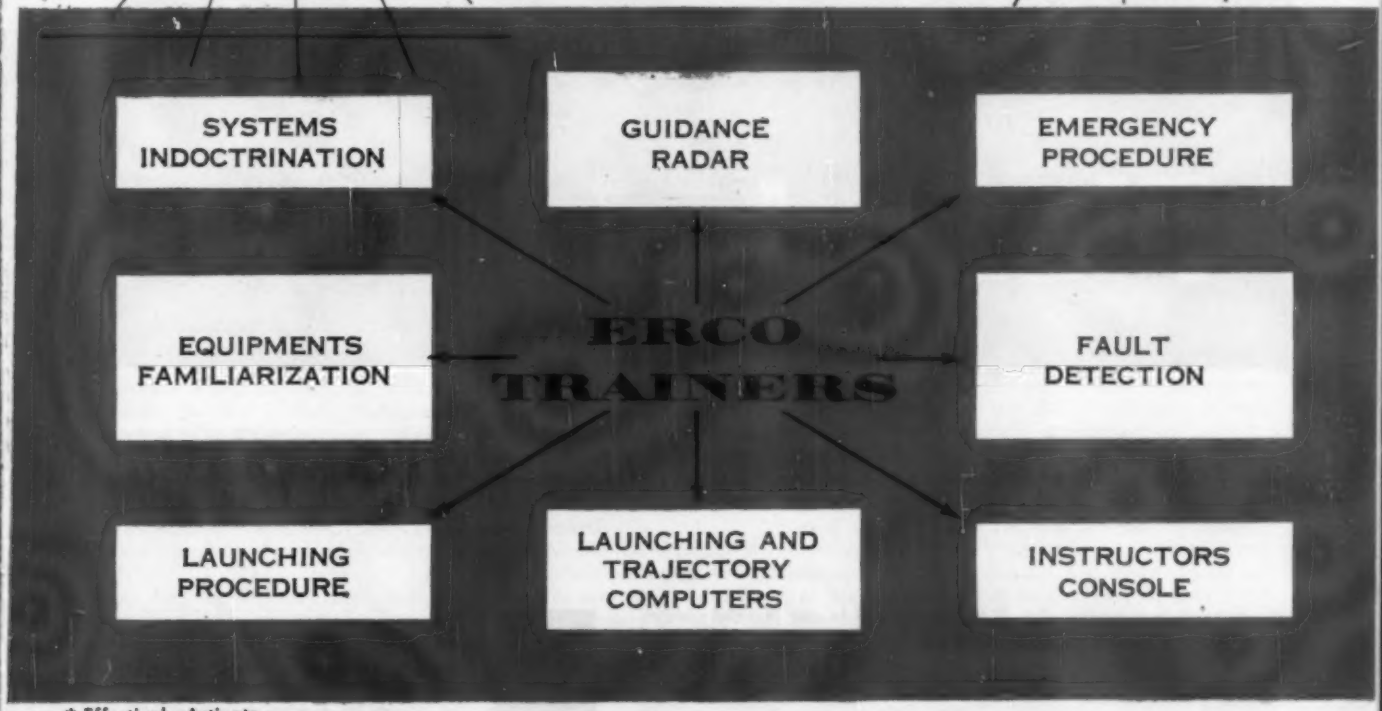

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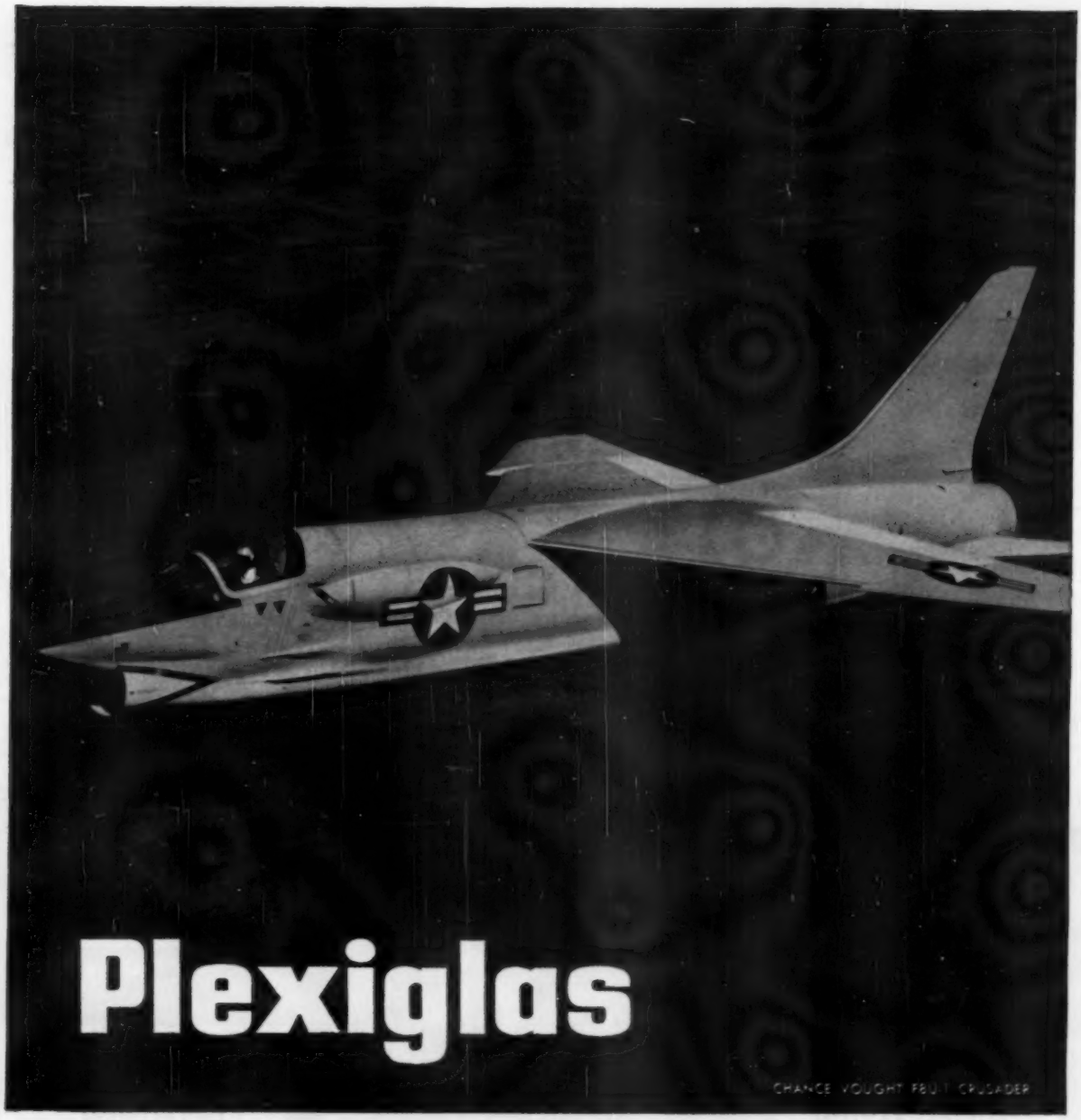

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Representatives in principal foreign countries

for the aircraft industry, have made no secret of the fact that they do not care for the doctrine which is cutting off all fighter development after the P.1 as well as leaving Britain's subsonic V-bomber force with no supersonic successors.

Defense Minister Sandys, on the other hand, is known to feel that development of a large supersonic bomber for the RAF would involve such a time lag that Britain now would be behind the field, in any event. To this, he prefers a rapid transition to missiles.

Sandys also believes the time is past when military budgets will carry a large part of the financial burden for civil aviation development.

One thing is certain as a result of the furor: the government now is going to find it necessary to defend in open debate policies which only a short time ago it considered settled.

Low speed radio-controlled flights have been made with a Swallow model configuration developed by Dr. Barnes Wallis, Vickers research chief, but on one of its final programmed flights the model got out of range and was lost in the sea.

No high-speed models were built, nor were mockups or prototype aircraft ever designed or built. Some observers see this as one reason for lack of continued interest by the Ministry and point out that if Wallis had frozen the configuration some time ago and built a manned flying model he might have been able to keep the project going.

Some type of catapult rig has been built near the Vickers research office at the Weybridge Works. Two sandbagged enclosures house firing personnel and the catapult, which is lined up parallel to the main runway at Weybridge. Presumably, such an apparatus would be used for making dynamically similar flight tests of scaled models.

Civil Air Research Gets Ministry Aid

London—Financial backing will be provided by the British government for research and development projects which are solely in the field of civil aviation.

Such help will be in addition to normal aeronautical research and development support for British defense needs.

"So far, the military and civil research have been one whole, done together," Supply Minister Aubrey Jones told the House of Commons. "The demand for military aircraft is subsiding. It is impracticable to pass over the whole of the civil research to the industry straightaway. The government therefore proposes to continue research as a whole, for the time being, at roughly the existing level. As the civil research becomes more and more identifiable, the cost of it will be passed on to the industry itself, though the actual execution of the research may well still be done within government establishment."

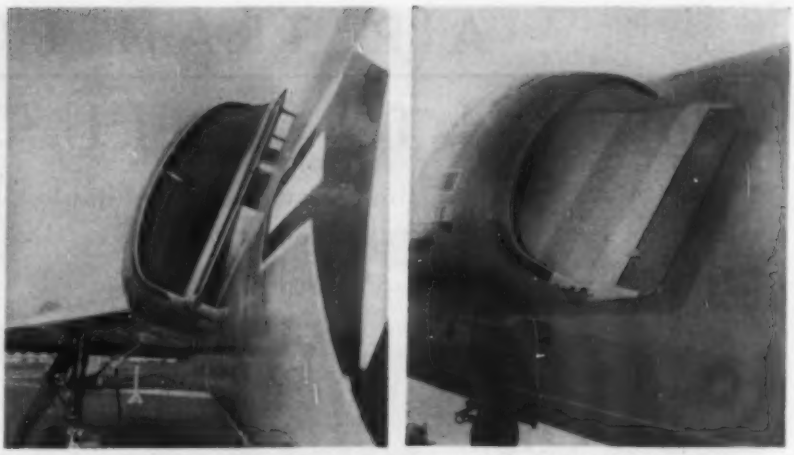
One of the first effects of the government policy is expected to be a green light for the proposed British supersonic airliner now under study by a consortium of major aircraft firms.

In return for government aid, the industry will be expected to take further steps to rationalize itself by reducing the number of firms which are active. At present there are 14 airframe manufacturers and five aero-engine firms. The Supply Minister questions whether there will be enough business in the next few years for more than two engine units and four major airframe manufacturers. He foresees reduction of the present work force of 250,000 to about 150,000.

Government decision to support civil research and development was taken in the expectation that in the course of time the industry itself will progressively assume financial liability for the civil research.

"It would be fruitless to continue this expenditure unless the industry reorganizes and strengthens itself to the extent necessary to meet the changed conditions with which it is now faced," Jones warned. "The future of research depends, then, on the progress made by the industry itself."

He noted that the industry already has accepted responsibility for most of the development costs of new civil airlines. But the supply minister said the Government recognizes the need for financial help in developing "a future generation of aircraft."



Geometry Control on F-106 Inlet

Varied combination of inlet boundary layer and geometry controls are employed in Convair's F-106 all-weather interceptor displayed at Armed Forces Day show in Washington. Geometry of inlet is varied by hinged ramp inside inlet which adjusts diameter for maximum efficiency. Sensor is visible on inlet's outer wall. Perforated section on boundary layer separator bleeds off air for inlet efficiency. Complex system of ducts is shown inside the separator. Outside ducts appear to dump air above and below inlet, but center ducts are scoops, for cooling air supply or other uses.

News Digest

North American Aviation's Missile Development Division announced last week the existence of Project RISE, (Research in Supersonic Environment) to gather test information concerning aerodynamics, guidance, propulsion and over-all system development well above Mach 1. The findings of this project will be applied to the B-70 bomber. Existence of the project and its goals was reported in the March 31 issue of Aviation Week (page 18).

Many other advanced programs also will benefit from the data that will be gathered. Project RISE has scheduled flights of the X-10 test vehicle for the Navaho missile program. During these flights, X-10s will be used as supersonic drones to test the effectiveness of various interceptor missiles.

President Eisenhower last week approved the purchase of three Boeing 707 jet transports for use by himself and other high ranking government and military officials. The three planes are scheduled to be delivered in early 1959 but there is a possibility of an earlier delivery late this year. The aircraft will be pooled for government use in the Special Air Missions Section of the Military Air Transport Service and will be flown on transcontinental or intercontinental official flights. It is the first time the Air Force has purchased jet transport aircraft for MATS use.

Qantas Bids for Cut of U.S. Local Market

Bid by Australian airline to compete in domestic market could open way for other foreign carriers.

By L. L. Doty

Washington—First bid by a foreign airline to compete in lucrative U.S. domestic markets is being made by Qantas Empire Airways.

In a petition filed with the Civil Aeronautics Board, the Australian national airline has asked for an interpretative ruling of the Air Commerce Act of 1926 that would give the airline the right to carry international passengers locally between points in the U.S.

The action has drawn sharp protests from both American Airlines and United Air Lines, the latter warning that the issues at stake will affect traffic throughout the entire domestic airline industry. Opposition of other U.S. trunklines will be handled through the Air Transport Assn., which will file an intervention petition with the Board.

According to most observers, the Qantas action, if successful, could open U.S. domestic markets to other foreign carriers now authorized to serve two or more co-terminals within the U.S. At present, 14 foreign airlines are authorized to serve 18 pairs of U.S. cities on their international routes.

Qantas' Position

Here is the position taken by Qantas in the first attempt to break into domestic markets:

• **Qantas has requested the Board** to construe Section 6(b) of the Air Commerce Act to mean that carriage of traffic by a foreign airline locally between U.S. points is not prohibited if such traffic is international. The Qantas petition further asks that such an interpretation apply even though the international traffic is carried from or to the U.S. by a foreign or international airline other than Qantas.

• **Specifically, the airline asks** the Board to declare that it has the right to carry a San Francisco-London passenger from San Francisco to New York where he will connect with some other carrier for continuing travel to London.

• **In the reverse direction** Qantas wants permission to receive from another foreign airline in New York a passenger traveling on a through ticket from London and carry him to San Francisco where he will either terminate or connect with another airline for onward transportation.

Qantas is now operating under a foreign air carrier permit issued by the Board on Dec. 24 following amendments to a bilateral agreement agreed upon by the U.S. and Australia on Dec. 3. The permit authorizes Qantas to serve Honolulu, San Francisco and New York as intermediate points on its around-the-world route.

Airline Objections

At the time the agreement was signed, large segments of the U.S. airline industry accused the State Department of expanding an established "give-away" policy which, they said, began with the grants of "one-sided" route advantages to the Netherlands and Germany.

Airline officials were quick to point out that before, the amendments to the Australian bilateral were drafted, the U.S. and Australia enjoyed fairly equal economic opportunities in the development of the U.S.-Australia transpacific route. Generally, the industry now estimates that Australia holds an eight-to-three traffic advantage over the U.S. as a result of the amendments.

U.S. carriers also charge that Australia had no operating rights to offer the U.S. of sufficient economic value to justify the transcontinental link authorized for Qantas. In exchange for the through route, the U.S. was given the right to fly from Australia to Antarctia and beyond, to New Zealand and southeast Asia and from Australia to Africa. According to one airline economist, most of these routes bear only a slight commercial appeal to U.S. operators.

United's Petition

The latest move by Qantas in seeking local traffic rights for international passengers already has reawakened much U.S. bitterness against the 1957 bilateral. In a statement to the Civil Aeronautics Board, United Air Lines warned that Qantas seeks "to usurp the connecting function presently performed by domestic carriers with respect to international traffic moving between major points of the United States." It added:

"... it is certainty that Qantas and other foreign carriers hope and will try to capture as large a part of that market (San Francisco-New York traffic) as they possibly can. There is no question but that the divisionary impact of Qantas' proposal on the domestic industry would be severe."

United Air Lines suggested in its statements that joint tariffs filed by foreign air carriers with the Civil Aeronautics Board indicate that some are already using their co-terminal authorizations to carry traffic locally to connect with other international carriers.

Joint Tariff Figures

Here are a few of the tariffs cited by United:

• **Los Angeles-Hamburg.** Joint fare is broken down with Trans World Air Lines or Western Air Lines covering the Los Angeles-San Francisco portion, Qantas, the San Francisco-New York portion and Lufthansa handling the balance.

• **New York-Tokyo.** British Overseas Airways Corp. covers the New York-San Francisco portion of this joint fare, Pan American World Airways or United Air Lines takes the San Francisco-Honolulu portion and Japan Air Lines or Pan American handles the balance. United points out that it has not agreed to any of the joint fares cited

Foreign Service

U.S. routes authorized for service by foreign airlines include:

San Francisco-Honolulu	Qantas, Japan Air Lines, Philippine Air Lines.
Honolulu-New York	Qantas.
San Francisco-New York	Qantas BOAC
New York-Seattle	Trans-Canada Air Lines.
New York-Boston	BOAC, Air France, Alitala, Irish Air Lines
New York-Chicago	BOAC.
New York-Detroit	BOAC.
Boston-Chicago	BOAC.
Boston-Detroit	BOAC.
Chicago-Detroit	BOAC.
New York-Washington	Aeronaves, Air France, Varig.
Boston-Washington	Air France.
New York-Houston	Air France.
New York-Miami	Avianca, Cinta.
Chicago-Miami	REAL.
New York-San Juan	Air France.
Miami-San Juan	British West Indian, REAL.
Miami-New Orleans	REAL.

on grounds they are illegal.

According to interpretations of the bilateral agreement by protesting American carriers, Qantas is authorized to carry passengers between any two or more U.S. points named in its foreign air carrier permit when the passenger is traveling on Qantas to or from a foreign point.

In its motion to dismiss the Qantas petition, American Airlines said air transportation by a foreign air carrier to, from and within the U.S. must first be authorized by section 402 of the Civil Aeronautics Act of 1938. It adds: "Only if the transportation is so authorized is it necessary to take the further step of ascertaining whether the air transportation involved may violate the cabotage clause of section 6(B)" of the Air Commerce Act.

Cabotage Principle

Key to the entire controversy is the principle of cabotage which, most airline attorneys agree, has no accepted legal definition in terms of international aviation. In 1947, former Civil Aeronautics Board Chairman James Landis, described the principle this way:

"Cabotage is the handling of traffic within the traditional jurisdiction of a particular state; that is, the traffic between New York and Miami is cabotage from the standpoint of any foreign airline."

Most airline attorneys agree that cabotage is similar in scope to a "closed-door" restriction and insist that the cabotage principle must be given legal clarification to cover all international aviation if domestic carriers are to be fully protected from competition within the U.S. by foreign carriers.

Some airline operators, however, fear that chances of protection through the cabotage principle are slim since it runs contrary to the State Department's current free trade policy.

In its statement supporting its petition to intervene in the Qantas case, United said, ". . . the word 'cabotage' itself is seldom given express definition either legislatively or in reported opinions."

Consequently, the carrier based its case against the Qantas proposal on "governing statutes, treaties, executive agreements and pertinent decisions of the Board." American cited numerous CAB decisions in the past to support its stand against the Qantas petition.

Traffic Threat

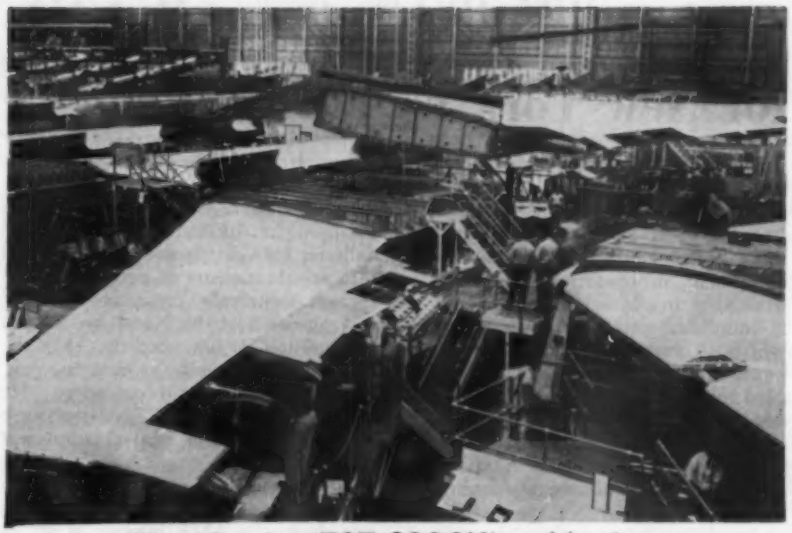
Threat of a loss of traffic to domestic airlines if Qantas is successful in obtaining local rights may unify the industry in a strong stand against any further grants of operating rights within the U.S. to foreign air carriers. Most airlines agree that the industry has been divided in the past on a number of issues involving bilateral treaties with other countries.

Certain grants that have been harmful to some carriers have either helped or not affected others with the result that protests did not always have the firm backing of the entire industry.

In addition, most bilaterals granting new routes to foreign carriers have not directly offered new competition to domestic carriers but have been confined to the international field.

By 1957, the number of foreign airlines sharing the U.S. market had grown to 39 and the share of U.S. carriers had dropped to 63%. During the nine year period, percentage of U.S. citizens among all international travelers has increased from 60% to 63%.

However, the granting of inland ports of entry to foreign airlines threatens to divert some potential domestic traffic that would normally connect at coastal ports to direct international routes. United Air Lines estimates that last September, international carriers operating the polar route from Los Angeles and San Francisco carried a total of 110 eastbound passengers daily who might otherwise have moved by domestic carriers.



First Boeing 707-320 Wing Mating

Wing for first Boeing 707-320 intercontinental jet transport is joined to center section at Boeing Airplane Co.'s Renton, Wash., facility. Aircraft is 12th in the 707 production cycle. First 320 will be delivered this year to Pan American World Airways.

CAB Bureau Proposes Turbojet Licenses

Washington—Civil Aeronautics Board Bureau of Safety has proposed the issuance of provisional certification of multi-engine turbine-powered aircraft for which type certificates have not been granted.

Under the proposed regulation covering provisional certification, airlines would be permitted to conduct crew training, service testing and simulated operations with turboprop and turbojet transports prior to type certification of the planes.

Purpose of the regulation is to accelerate the introduction of jet equipment into scheduled service.

Need for the special civil air regulation resulted from an opinion by the Civil Aeronautics Administrator that his authority under existing regulations was inadequate to permit the extensive training programs contemplated by the airlines prior to the introduction of the planes into commercial operation.

Here are the essential points of the new regulation proposed by the Bureau of Safety to the Board:

- **Provisional type certificates** for turbine powered aircraft can be issued to any manufacturer who has previously received a type certificate for at least one airplane and has a currently effective production certificate. Application for a transport type certificate for the aircraft must be made before the provisional type certificate will be issued.
- **Applicant must have flown** the aircraft for which a type certificate has been applied for 100 hours in all maneuvers required for certification. Provisional type certificate shall remain in effect for at least six months.
- **Aircraft must undergo CAA** flight test program before a provisional certification can be issued. CAA must be assured that development of the aircraft has proceeded to a degree that will ensure type certification within six months.

New Navigation Units Planned for New York by Early 1960

By Robert H. Cook

Washington—Airways Modernization Board expects to have its first experimental navigation and communications equipment in operation in the New York City area by early 1960.

Simulated testing of the equipment will take place at the AMB's new Atlantic City test center, which is scheduled to begin operations this July. Success of the New York experiment could signal the replacement of existing facilities across the nation by AMB-tested procedures and equipment, according to AMB chairman, Elwood Quesada.

Appearing before a recent hearing of a House Appropriations Subcommittee on AMB's requested $35 million budget for Fiscal 1959, Quesada said most of the appropriation was needed for "immediate" establishment of a "unified" research and development program designed to bring the earliest possible improvement to the nation's aviation facilities. Quesada told the subcommittee that the Board intends to adopt or further develop many types of equipment and techniques not now generally used for air traffic management, but which are available for adaptation.

Development Cost

In a budget breakdown, the chairmen estimated that $2.9 million would be needed for an analysis of problems to be solved, $3.8 million for synthetic testing equipment, $12.5 million for experimentation costs to include the equipping of the test center and $15.2 million for developmental contracts with private industry on equipment that appears technically promising.

Acquisition of the Naval Air Station at Atlantic City advanced the AMB development program by at least one year, Quesada told the subcommittee. He said that more than 1,800 sites were considered before a final decision was made.

Designated the National Aviation Facilities Experimental Center, the site was chosen by AMB because of its location in a high-density traffic area encompassing critical air defense operations. Teams of scientists, pilots, air traffic controllers and engineers will staff the center at an annual estimated cost of $3.5 million.

Automatic Display

While AMB has been in existence less than a year, it already has made progress in a number of fields, including a contract for an automatic data processing and display electronic system for air controllers to General Precision Laboratory. The unit would make possible the complete automation of flight plan reception, computation of times of arrivals and fixes, conflict detects, revision of new times of arrivals, scheduling for landing and outbound flights and communication between controllers. It also includes automatic flow-control computation, position reporting and data for aircraft identification for the military.

Failure of a pilot to file a position report would automatically warn the controller to begin automatic tracking by a 3-D radar, using the third dimension of altitude. All information computed can be culled from the computer in a "microsecond." AMB expects delivery on the first set for experiment next January and recently awarded a contract for three terminal sets, to be located at three terminals in the New York area, to General Precision.

To make full use of the automatic data processing display, AMB will take delivery on a "a real and fast time" simulator early next year. This electronic machine will simulate several hundred aircraft in flight, at both real speeds or as high as 20 times actual speeds. It will make possible the testing of new systems of air traffic control with human operators and a speeding of statistical analysis of traffic flow patterns.

Quesada said AMB is continuing experiments with the Doppler navigation system being used for air defense purposes and has installed sets on New York Airways helicopters. Favored because of its high degree of accuracy, the system is now being used by BOAC and other foreign carriers.

He added that work also was going ahead on an anti-collision device although no solution was available for the problem at this time.

Runway Improvements

Runway improvement projects also are well under way and the Port of New York Authority is changing configuration of the highspeed turnoff ramps at New York International Airport as a result of AMB flight research. Further studies are being made at LaGuardia, and AMB is conducting forecasts to try and define problems of aircraft density and traffic control as far in the future as 1970. Quesada told the subcommittee:

"We must design equipment to 1975 . . . otherwise we will be in the same position we are in today. . . . 1945 equipment in 1958."

The AMB chairman said the entire program is being carried out with the close cooperation of the military and that AMB expects to have its air traffic control system so well advanced that air defense planes will be able to penetrate heavily traveled airways with little danger of collision with a civilian aircraft.

No-Show Penalty

Washington—Air Traffic Conference last week voted to drop the $3 no-show penalty charge adopted by the airline industry in September as a means of curtailing the no-show problem.

The plan, which recently drew strong opposition from American Airlines, will be discontinued on Aug. 12. The Conference, however, voted to extend until Dec. 1 the two other phases of the overall no-show plan—minimum time limit on the pickup of tickets and the reconfirmation rule.

In addition to the elimination of the penalty charge, Mohawk Airlines, at its own request, was exempted from the minimum time and reconfirmation rules effective Aug. 12. Allegheny Airlines also will be extempted from all three phases of the plan on routes which are competitive with Mohawk.

The Air Traffic Conference will meet on Dec. 1 in Houston to further review the two remaining rules of the no-show plan.

Subsidy Request Filed by Flying Tiger

Washington—Flying Tiger Line, strongest of the four certificated all-cargo carriers, has filed a request for subsidy with the Civil Aeronautics Board.

Arguments offered by the carrier highlight the difficulty the cargo carriers are experiencing and are based on similar subsidy requests filed earlier by Riddle, Slick and AAXICO.

Although Flying Tiger said it was not in any "immediate financial crisis," and, therefore, was not requesting any set amount of subsidy, it pointed out that the current business recession could place it in "dire straits" in the future.

Net income of the carrier dropped from a high of more than $2.9 million in 1956 to only $102,000 last year, reflecting an average monthly loss of $134,000.

Flying Tiger attributed at least part of the decline to the Military Air Transport Service and the Logair and Quicktrans movements of the Air Force and Navy. It charged that the military transport system threaten to ruin the all-cargo industry and charged that

MATS has "deliberately ignored" congressional directives to award 40% of its passenger and 20% of the cargo business to civilian carriers.

The report said transcontinental freight operations of Logair and Quicktrans total 170 million ton miles annually and threatens to surpass the total tonnage handled by the all-cargo carriers and trunkline operations.

Three Lines Proposed for Midwest Routes

Washington—Northwest, Capital and Eastern Air Lines have been recommended for route extensions in the current Chicago, Milwaukee-Twin Cities Case.

Civil Aeronautics Board Examiner James S. Keith in his initial decision recommended nonstop authority for Northwest between Minneapolis/St. Paul, Milwaukee and Chicago. He also recommended nonstop authority between these cities and Atlanta, Tampa and Miami. The carrier earlier was granted nonstop authority from Chicago to Florida in the Great Lakes-Southeast Case.

Capital Airlines was recommended for an extension of its Route 14 from Chicago to serve Minneapolis/St. Paul via the intermediate point of Milwaukee. The recommendation would eliminate a restriction of service between these points to flights only from Detroit or originating or terminating to the south or east of this city.

Eastern Airlines was recommended for an extension of its Route 10 from Chicago to Minneapolis/St. Paul via Milwaukee to provide the first one carrier service between the Twin Cities and Louisville, Indianapolis and Cincinnati.

Examiner Keith also recommended the removal of a restriction on United Airlines Route 1 which prevents the airline from serving Milwaukee on flights from Chicago.

Western Reports Income

Western Air Lines, despite a pilot strike, reports a net income for the first quarter of $135,863. First quarter operating loss of $524,137 was offset by gains from the sale of used aircraft. Company had paid shareholders 40 cents in regular cash dividends per share since the beginning of the year, plus a 4% dividend distributed in March.

Western has signed contracts with six of the seven unions represented within the company, including an agreement signed recently with the Brotherhood of Railway Clerks. Strike of pilots has been in effect for nearly three months.

CAA Requests $438 Million for Long-Range Radar System

Washington—Civil Aeronautics Administration has placed heavy emphasis on the use of long-range radar for the federal airways system in its requested 1959 budget of $438,700,000.

Reflecting an increase of more than $92 million over current appropriations, CAA's budget presentation before a House Subcommittee on Appropriations called for $34.8 million for long-range radar in addition to $21.6 million for terminal area radar.

Civil Aeronautics Board has asked the subcommittee for $46.8 million of which $40.7 million is earmarked for subsidy payments which chairman James Durfee predicts may climb to a new level before the end of next year.

Largest item in the CAA budget calls for an extension of VORTAC air navigation facilities at a cost of more than $51.9 million. Total maintenance and operational costs for the 1959 federal airway plan would be $204,850,000, according to CAA Administrator James T. Pyle.

New Facilties

During the past two years, CAA has installed 1,200 new navigation and air control facilities and has placed new air traffic control techniques for flights above a 24,000 ft. altitude into operation. Pyle said the administration expects to expand its air control by September to monitor airspace between 15,000 and 24,000 ft., with future control going as low as 700 ft. for navigation and communications purposes.

Budget Plans

Through this year, CAA has provided for the installation of 40 long-range radars of which 22 are for joint use with the military. The 1959 budget plans for 16 additional long-range radars equipped with amplitrons to extend the range up to a radius of 200 miles and altitudes approaching 80,000 ft., depending upon the size of the aircraft. The new radars are as much as 60% more powerful than those in present use.

Calling attention to a need for more radar equipment, Pyle said CAA handled more than 17 million itinerant flights last year. Instrument landing approaches increased 37% between 1956 and 1957, highlighting the need for Precision Approach Radar as a backup safety measure in case of ILS failure. Pyle said he expects ILS approaches to total 3.1 million by 1970.

One of the heaviest expenditures planned for improved air traffic control is $13.5 million for airport surveillance

'Supermarket' Customs At Idlewild Terminal

Incoming international passengers are processed through Customs in new International Arrivals Building at New York International Airport, now in operation for its first summer season. Shown are one of two customs areas photographed in March, just before beginning of peak season. Limited Port of New York Authority studies indicate reduction of average off-season passenger time through Customs, Public Health and Immigration from 53 min. in old terminal to under 30 min. in new building. Acid test of new system, which incorporates self-service baggage bins and wheeled carts, will come this fall with peak westbound movements on the North Atlantic.

radar in the terminal area radar budget.

Pyle said much of the over-all cost of the program could be borne by the proposed airway user charge plan which would raise estimated aircraft fuel tax revenues from $65 million in fiscal 1959 to $211 million in 1963.

CAB Chairman Durfee told the subcommittee that, although subsidy payments projected for 1959 were on a par with this year, he believes they will definitely be increased because of new routes and equipment being acquired by the carriers. About 84%, or $34 million, of the total subsidy payments will be made to 13 local service carriers by 1959, while 14% will be provided for territorial carriers. The balance is related to foreign operations of Braniff Airways. No trunklines are presently on subsidy.

Recent passage of the Guaranty Loan Act enabling local service carriers to replace obsolete flight equipment should ultimately remove them from subsidy.

Durfee explained that such re-equipment programs were largely responsible for removing the trunklines from subsidy. He added that pending CAB actions on improved route structures, removal of restrictions, possible skip stop operations and a new rate of return formula would combine to eventually make the local service carriers free of subsidy.

Airline profits in general have decreased substantially but should show a decided gain by the end of this year because of the recent 6.8% fare increase, Durfee said in predicting a $100 million profit for domestic carriers based on projected traffic figures.

CAB, he said, is "in basic sympathy" with pending legislation to prevent any certificated carrier to return to subsidy once it has been removed but feels there may be some difficulty in applying such an "automatic standard." He cited the case of Northeast Airlines which, he said, may possibly be forced to file for subsidy, since the Northeast's operations in New England have experienced heavy losses.

The Board expects to make its first decision on the rate making procedures of the General Passenger Fare Investigation by the first quarter of next year, Durfee said. Work is expected to begin on the question of a rate structure before the end of this summer, he added.

Progress is being made in the separate rate of return—local service carriers case but a final decision from the Board may take another year, he said.

Passenger Decline, Higher Costs Cut Lines' First Quarter Profits

Washington—Airline business continued to react to the current economic recession during April with passenger load factors remaining below the 60% level for the seventh consecutive month.

Earnings reports from the domestic trunklines for the first quarter of 1958 indicate that profits are being cut deeply by the leveling-off of passenger traffic and by a cost increase that shows no signs of abating. Industry net earnings for the period may be cut by as much as 55% as compared with the same period last year.

Load factor for the domestic trunklines during April was 59.94%, a 2.36 percentage point decline from that of a year ago. Load factor for the year ending in April was 60.73%, the lowest 12-month load factor recorded since the year which ended in October, 1950.

Total revenue passenger miles climbed 9.5% above a year ago during the year ending in April, the smallest year-to-year percentage increase since the 12 months ending August, 1949. April showed a 1.2% increase in passenger miles over the same month of last year, an improvement compared to March when a .2% decrease was reported.

Capital Airlines last week made a major move toward chopping expenses when it began a system-wide economy program that may result in an across-the-board personnel cut by as much as 15% of the present complement. The airline reported a net loss of $1.4 million for the first quarter of the year as compared with a net loss of $1.8 million for the same period of 1957.

Three directors of the company resigned last week because, according to a Capital spokesman, the company's financial problems were absorbing an inordinate amount of their time. The three directors are J. D. Stetson Coleman, Thomas D. Neelands and Harold B. Smith.

Trans World Airlines announced a net loss of $11 million for the first quarter despite an all-time first quarter high of $59.5 million in operating revenues. The airline lost $6.1 million during the first three months of 1957.

TWA attributed the loss to the "squeeze of rising costs" and noted that the increased cost of doing business was reflected in every category of operating expense except general administrative. The airline said the interim fare increase which became effective on Feb. 10 produced additional revenue through March of $1.3 million.

Continental Airlines showed a net loss of $307,175 during the first quarter compared to a net income of $63,232 for the same quarter last year. Operating expenses climbed 35% during the period with operating revenues increasing 22% to $5.6 million, compared to $4.6 million for the three month period last year.

Net income for Delta Air Lines, which reports on a fiscal year basis ending in June, recorded a net profit of $332,439 for the nine months ended in March compared to a net profit of $1.5 million for the same period in 1957.

United Air Lines showed a net loss of $384,593 after a gain of $215,371 from the sale of aircraft during the first quarter. This compares with a net profit of $347,240 for the first three months of 1957.

W. A. Patterson, president of the airline, attributed the loss to "costs that continue to rise and fares that continue to yield inadequate returns." Operating revenues of the airline totaled $66.1 million, a 10% increase over 1957. Operating expenses reached $66.7 million, an 8% increase.

International airlines were experiencing similar difficulties in traffic declines. The International Air Transport Assn. attributed an 8.5% decline in load factors to the U.S. recession. However, most observers seem to be under the impression that the 23% increase in available seat miles and the 20% increase in the number of flights on the North Atlantic route was a major factor in the load factor drop.

Senate Approves Airport Funds Bill

Washington—Senate last week passed legislation authorizing an "emergency" fund of $75 million for airport construction.

The measure increases the annual federal allocation for airport development from the present $63 million to $100 million, starting with the 1959 fiscal year.

It was opposed by the Commerce Department. Louis Rothschild, Under Secretary of Commerce for Transportation, maintained that local communities should fully finance their own airports. Civil Aeronautics Board gave its support to an expanded airport program to meet the requirements that "the advent of jet and other high speed aircraft will bring." In addition, CAB said that "in the case of airports serving intermediate and smaller communities, it is entirely possible that improved runways and taxi facilities will be required with the contemplated introduction of larger capacities of intermediate aircraft and improved local service aircraft."

Airlines Report Officer Salaries, Bonuses

Washington—Following is a list of airline officers and directors and their salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, as reported to the Civil Aeronautics Board.

Trunk Airlines

CAPITAL AIRLINES INC.—J. H. Carmichael, chairman, board of directors, $58,200 salary and 1,998 shares of common stocks; **D. H. Baker**, president and director (joined Capital in July), $25,000 salary and no stock; **R. G. Lochiel**, treasurer and director, $33,000 salary and 4,000 shares of common stock in name of others; **J. W. Austin**, vice president and director (resigned 12/31/57), $30,799.92 salary and 12,046 shares of common stock; **J. B. Franklin**, vice president, $28,600.08 salary and 350 shares of common stock; **R. J. Wilson**, vice president, $24,474.96 salary and 198 shares of common stock; **H. Dever**, executive assistant to the president and secretary, $19,242.92 salary, 1,900 directly owned common shares and 100 common shares of stock in name of others; **S. B. Goldthorpe**, assistant vice president and comptroller, $17,291.74 salary and 502 shares of common stock.

R. W. Hardesty, assistant vice president, $17,141.58 salary and 100 shares of common stock; **S. T. McAllister**, assistant vice president, $13,925 salary and no stock; **N. B. Fry**, assistant vice president (resigned 12/31/57), $13,900 salary and no stock; **J. Daniels**, assistant vice president, $9,075 salary and no stock; **W. B. Smith**, assistant secretary, $8,435 salary and no stock; **R. P. Wright**, assistant treasurer, $16,200 salary and 375 shares of common stock; **O'F. Estes**, assistant treasurer, $13,058.40 salary and no stock.

C. H. Murchison, director, $9,075 salary and 10,632 shares of common stock; **J. D. S. Coleman**, director, $500 bonus and indirect compensation, 500 directly owned common shares and $10,000 worth of 4½% debentures; **W. V. Couchman**, director, $700 bonus and indirect compensation and 220 shares of common stock; **D. L. Frawley**, director, $500 bonus and indirect compensation and 2,000 shares of common stock; **G. R. Hann**, director, $1,600 bonus and indirect compensation, 1,138 directly owned common shares and 44,694 common shares of stock in name of others; **C. T. Johnson Jr.**, director, $400 bonus and indirect compensation and 765 shares of common stock; **A. F. Kroeger**, director, $1,400 bonus and indirect compensation, 559 directly owned common shares and 441 shares of common stock in name of others.

C. B. Monroe, director, $1,500 bonus and indirect compensation and 152 shares of common stock in name of others; **B. D. McIntyre**, director (resigned 7/31/57), $300 bonus and indirect compensation and no stock; **T. D. Neelands Jr.**, director, $1,200 bonus and indirect compensation, 500 directly owned shares, 100 common shares in name of others and $160,000 worth of 4½% debentures; **H. B. Smith**, director, $700 bonus and indirect compensation and 378 shares of common stock; **J. R. Stockton**, director, $500 bonus and indirect compensation.

Lewis E. Ryan, advertising services, $1,390,929; **Kenyon & Eckhardt**, advertising services, $487,407; **Adair, Ulmer, Murchison, Kent & Ashby**, legal services, $146,892; **Melbank, Tweed & Hope**, legal services, $45,112; **Lybrand, Ross Bros. & Montgomery**, audit and tax services, $25,197; **Boersnia Travel Service**, commission, $15,020; **Maloney & O'Connor Travel Bureau**, commission, $13,845; **James Wagenaar Travel Bureau**, commission, $13,429; **John B. St. John**, actuary fees, $11,194; **Aviation Advisory Service**, $10,873; **Midland Travel Service**, commission, $8,974; **Elkin Hotel & Travel Bureau**, commission, $7,963; **College Travel Service**, commission, $7,664.

Manufacturers Trust Co., trustee, $7,529; **Russell S. Fisher Travel Firm**; commission, $7,221; **Baxter O'Neill & Houston**, legal services, $7,072; **Elliot Travel Service**, commission, $6,926; **Muskeegon Travel Bureau**, commission, $6,800; **D. B. Lederer**, M.D., medical fees, $6,524; **Holiday Travel Agency**, commission, $6,328; **Sheraton Cadillac Hotel**, commission, $5,701; **Taylor Travel Service**, commission, $5,402.

TRANS WORLD AIRLINES INC.—C. L. Burgess, president and director (resigned in December, 1957), $60,982.69 salary, $150 bonus and indirect compensation, $11,260.61 expenses and 19 shares of common stock; **W. L. Pierson**, chairman, board of directors, $67,029.22 salary, $10,958.10 bonus and indirect compensation $2,290.26 expenses and 200 shares of common stock; **E. O. Cocke**, senior vice president-sales director, $36,138.91 salary, $5,855.50 bonus and indirect compensation, $6,791.82 expenses and no stock; **A. V. Leslie**, senior vice president-finance, treasurer and director, $36,138.91 salary, $3,415 bonus and indirect compensation, $5,514.35 expenses and 90 shares of ccmmon stock; **G. H. Clay**, vice president-administrative services and director, $23,891.85 salary, $2,156.40 bonus and indirect compensation, $3,413.84 expenses and 1,331 shares of common stock.

F. W. Ayers, director, $200 salary, $140 bonus and indirect compensation, $1,497 expenses and no stock; **P. Bradley**, director, $800 salary, $140 bonus and indirect compensation, $825 expenses and no stock; **N. Dietrich**, director, $300 salary, $140 bonus and indirect compensation and no expenses or stock; **A. Eisenhower**, director, $300 salary, $140 bonus and indirect compensation, $241.83 expenses and no stock.

O. F. Holcombe, director, $500 salary, $140 bonus and indirect compensation, $1,059.57 expenses and no stock; **S. Maestre**, director, $700 salary, $140 bonus and indirect compensation, $458.52 expenses and 332 shares of common stock; **M. E. Montrose**, director, $600 salary, $140 bonus and indirect compensation, $1,000.18 expenses and no stock; **C. H. Price**, director, $700 salary, $140 bonus and indirect compensation, $1,856.62 expenses and no stock; **H. E. Rogers**, director, $900 salary, $140 bonus and indirect compensation, $3,037.97 expenses and no stock; **B. F. Sessel**, director, $800 salary, $140 bonus and indirect compensation, $134.27 expenses and 334 shares of common stock; **A. D. Simson**, director, $1,000 salary, $140 bonus and indirect compensation, $2,225.10 expenses and no stock; **T. A. Slack**, director, $500 salary, $140 bonus and indirect compensation, $382.76 expenses and no stock; **W. Wright**, director, $600 salary, $140 bonus and indirect compensation, $724.59 expenses and no stock.

J. W. Thomas, vice president, $18,438.73 salary, $1,474.50 bonus and indirect compensation, $7,781.71 expenses and no stock; **G. L. Gilmore**, vice president-public relations, $20,593.73 salary, $2,080.09 bonus and indirect compensation, $4,544.33 expenses and 41 shares of common stock; **T. K. Taylor**, vice president, $23,796.85 salary, $1,700.30 bonus and indirect compensation, $11,335.17 expenses and 236 shares of common stock.

R. E. Montgomery, vice president-regional sales, $20,163.67 salary, $2,407.10 bonus and indirect compensation, $6,132.17 expenses and no stock; **L. P. Marechal**, vice president-regional sales, $17,978.25 salary, $1,673.20 bonus and indirect compensation, $5,183.83 expenses and no stock; **J. D. Harrigan**, vice president-regional sales, $15,558.32 salary, $1,661.32 bonus and indirect compensation, $2,950.05 expenses and no stock; **J. E. Letzkus**, vice president-regional sales, $20,040 salary, $10,743.17 bonus and indirect compensation, $9,223 expenses and 400 shares of common stock; **A. L. Stewart**, vice president-regional sales, $19,628.41 salary, $160 bonus and indirect compensation, $8,010.82 expenses and 100 shares of common stock.

R. Mazzarrini, vice president-regional sales, $16,920 salary, $7,888.86 bonus and indirect compensation, $8,502.97 expenses and 100 shares of common stock; **F. G. Betts**, vice president-purchasing, $21,769.66 salary, $4,162 bonus and indirect compensation, $1,030.73 expenses and no stock; **J. H. Clemson**, vice president, $24,742.15 salary, $5,017.80 bonus and indirect compensation, $3,737.60 expenses and 84 shares of common stock; **C. E. McCollum**, vice president-national accounts, $19,893.60 salary, $4,960 bonus and indirect compensation, $2,710.80 expenses and 198 shares of common stock.

C. S. Fullerton, vice president and general sales manager, $25,243.63 salary, $3,041.50 bonus and indirect compensation, $5,601.39 expenses and no stock; **R. M. Dunn**, vice president-overhaul, maintenance and stores, $21,281.94 salary, $5,009 bonus and indirect compensation, $2,060.03 expenses and no stock; **F. E. Busch**, vice president-operations, $31,414.07 salary, $6,797.10 bonus and indirect compensation, $5,083.80 expenses and no stock; **P. G. Desautels**, vice president-passenger services, $19,079 salary, $6,232.41 bonus and indirect compensation, $6,715.62 expenses and 254 shares of common stock; **R .W. Rummel**, vice president-engineering, $19,687.86 salary, $4,510.30 bonus and indirect compensation, $4,819.04 expenses and no stock; **J. L. Weller**, vice president-planning and coordination, $20,121.54 salary, $4,913.90 bonus and indirect compensation, $2,154.90 expenses and no stock; **R. Duckworth**, corporate secretary, $17,287.17 salary, $1,528.60 bonus and indirect compensation, $749.43 expenses and no stock.

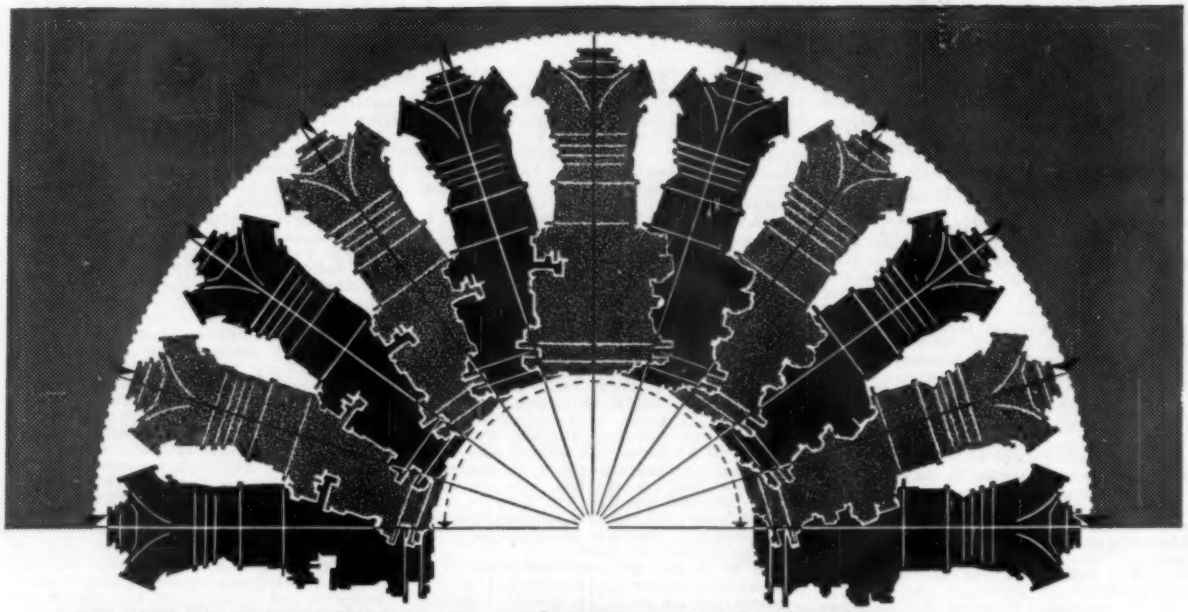
Airport Medical Center, Los Angeles, physical examinations for employes, $8,517; **Airport Concessionaires Inc.**, operation of Los Angeles Ambassador club bar; $9,745.14; **Abbey Limousine**, limousine service, $12,031.30; **J. H. Beyer**, display specialist, $6,598.20; **Blaxter, O'Neill & Houston**, TWA's prorate share of legal services, $5,138.86; **Caldwell & Associates**, consulting engineers, $5,200; **Carey Cadillac Inc.**, limousine services, $34,959.65; **Chadbourne, Parke, Whiteside & Wolff**, legal services and resident attorney fees, $409,396.63; **Wallace Clark & Co. Inc.**, management consultants, $70,323.92; **Coverdale & Colpitts**, consulting engineers, $121,495.04; **Cresap, McCormick & Paget**, management consultants, $44,689.53; **Ebasco Services Inc.**, actuarial services, $6,893.35; **Foote, Cone & Belding**, advertising charges and commissions, $56,504.98; **Haskins & Sells**, audit fees and professional services, $19,010.

Heart of America United Campaign, contribution, $11,250; **Horwath & Horwath**, survey- services, $6,357.31; **The Interstate Co.**, operation of San Francisco Ambassador club bar, $14,099.30; Institute of Visual Training Inc., service charge for booking, inspecting and shipping film, $35,980; **Irving Trust Co.**, services in connection with lean agreement and sinking fund, $19,988.11.

New York Trust Co., transfer agent for company stock, $46,389.28; **J. B. Redwine**, flight training, $22,299.20; **Stevens Institute of Technology**, research service, $6,090; **Stinson, Mag, Thomson, McEvers & Fizzell**, legal services, $8,852.32; **Universal Agency Inc.**, advertising commissions, $18,540.50; **Waters, Arditto & Waters**, tax consultants, $6,500; **Winthrop, Putnam, Roberts**, legal services, $10,000; **Mario Zamparelli**, painting murals in TWA's Lockheed 1649A Constellation aircraft, $26,000.

SHORTLINES

▶ **Allegheny Airlines** reports a new April passenger traffic record of 39,327 passengers flown more than 6,400,000 miles, an increase of 13% over April, 1957. Allegheny is scheduled to begin nonstop services between Pittsburgh, Atlantic City and Wildwood-Cape May



DESIGNERS WELCOME THE NAPIER GAZELLE

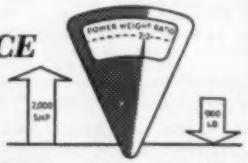
'Any angle' installation gives greater freedom

Napier's Gazelle offers a welcome break to 'tied' helicopter designers. This rugged free-turbine engine can be mounted on simple supports in the helicopter structure UPRIGHT, HORIZONTALLY, OR IN ANY POSITION IN BETWEEN.

This 'any angle' installation relieves the designer of many accepted limitations. It also gives him more opportunity to make proper use of fuselage space—valuable space which should, after all, be used for payload accommodation.

The Bristol 192—chosen by the Royal Air Force—is powered by two Gazelles.

HIGH PERFORMANCE —LOW WEIGHT



The Gazelle has an impressive power/weight ratio. Originally designed for a power output of 1,260 s.h.p., it is now well on the way to developing 2,000 s.h.p. for a weight of 900 lbs.—a ratio of 0.45 lb./s.h.p. By removing the need for clutches, cooling fans, etc., the free turbine arrangement knocks pounds off the weight of the transmission mechanism.

30% RESERVE POWER

The design of the Gazelle provides a range of ideal helicopter powers. Among them are short-period emergency power outputs up to 30% above the normal maximum. Helicopters demand tough, reliable engines: the Gazelle is designed for strenuous duty and long service between overhauls. And when the time for overhaul comes, economical speedy maintenance is assured by the Gazelle's essential simplicity and the 'unit' principle on which it is built.

REPAIRS BY REPLACEMENT

This principle means that Gazelle components and assemblies are interchangeable—and easily accessible. Reduction gear, free turbine, compressor turbine and combustion system, compressor and accessories can all be replaced as self-contained, individually tested assemblies. The metering control unit can also be replaced as a rig-tested unit needing only minor adjustment.

NAPIER ENGINES INC.
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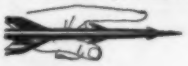

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CRC 67

and between New York and Atlantic City in May and June.

► **Air France,** in cooperation with SITA World Travel, European travel agency, is sponsoring three unusual two-week tours of France and Greece. French tour includes Corsica, Biarritz, Avignon, Carcassonne, Caen and Chartres; Grecian tour includes the island of Delos, Crete, Corfu and Rhodes as well as trips through the Greek mainland and the Peleponese and visits to Delphi, Thebes, Marathon and Corinth. Tours may be made on Air France economy-class flights to Europe and tourist-class within Europe, with first class rail and motor-coach facilities. Fares range from $744.60 to $882.50 including air and land transportation, choice of hotel accommodations and meals.

► **Civil Aeronautics Board** has ordered an investigation into a request by four airlines for fare increases from Seattle to Anchorage, Fairbanks and Juneau, Alaska, amounting to 20, 17 and 16%. The increases requested by Alaska Airlines, Northwest Airlines, Pacific Northern Airlines and Pan American World Airways have been suspended.

► **KLM Royal Dutch Airlines** reports $26,522,000 in total operating revenues for the first quarter of 1958, a decline of $624,000 from the same period of last year. Net losses after all charges and provisions totaled $1,788,000, or $1.25 per share, as compared with $29,000 and $0.02 per share for the first quarter of 1957.

► **Ozark Air Lines** flew 34,750 passengers during April, a 16% increase over the same month of 1957. For the first four months of this year, Ozark carried 131,379 passengers and maintained a passenger load factor of 50.79% as compared with 108,027 passengers and a load factor of 45.09% during the first four months of 1957.

► **Seaboard & Western Airlines** has extended its all-cargo service to Basel, Switzerland, the 16th European city served on the airline's international routes. Three flights weekly will be made on the New York-Shannon-Paris-Geneva-Zurich-and-return route. Seaboard & Western recently signed interline agreements with seven international airlines—Austrian Airlines, Aerlinte Eireann, Jersey Airlines, Pacific Western Airlines, Polish Airlines (LOT), Quebecair and Trans Caribbean Airlines. All are members of the International Air Transport Assn. Seaboard & Western flights using all cargo aircraft will leave New York on Tuesday, Thursday and Friday and return from Basel on Saturday, Monday and Thursday.

AIRLINE OBSERVER

► **Civil Aeronautics Board has dropped its policy of automatically giving confidential treatment to preliminary year-end airline reports. Under the Board's new policy, each carrier may request confidential treatment of its preliminary reports, but the Board will decide on the merits of each case whether or not confidential handling is in the public interest.**

► Negotiations with the Japanese government on amendments of the U.S. bilateral agreement have broken off following failure of the Japanese to accept U.S. proposals by the April 23 deadline. Industry observers are split in their views as to whether the action suggests that the State Department has adopted a stronger position in bilateral negotiations than has been evident in the past. Japan has offered to permit an increase in Northwest Airlines flight frequencies into Tokyo but, as one airline official explained, there never was a restrictive clause on capacity in the original agreement. The limited capacity factor was adopted as an afterthought by the Japanese government and is being used as a bargaining weapon in the attempt to obtain a new route for Japan Air Lines to Los Angeles and beyond.

► **Watch for a report to Congress next month on a working agreement between the Civil Aeronautics Board and the Defense Department covering maximum use of commercial airlines for the transportation of military traffic. A joint working group of the Board and Defense has met on five occasions since April 7 and plan weekly meetings until the project is completed. Intervals between meetings are filled by the necessary staff work.**

► Russian Tu-104 jet transport charter flight transporting Moscow Arts Theater group to Great Britain has been denied entry into London Airport because of the noise level of the aircraft. Noise is a major issue in the recently signed bilateral agreement between the Soviet Union and United Kingdom (AW March 24, p. 11). The agreement states that aircraft of each county will operate under established noise levels before the Moscow-London service can be implemented.

► **American Airlines has become the first airline to order Vortac type distance measuring equipment. New DME-T, to be used on Boeing 707 jet transports, will be produced by Federal Telephone and Radio Co., a division of International Telephone & Telegraph Corp.**

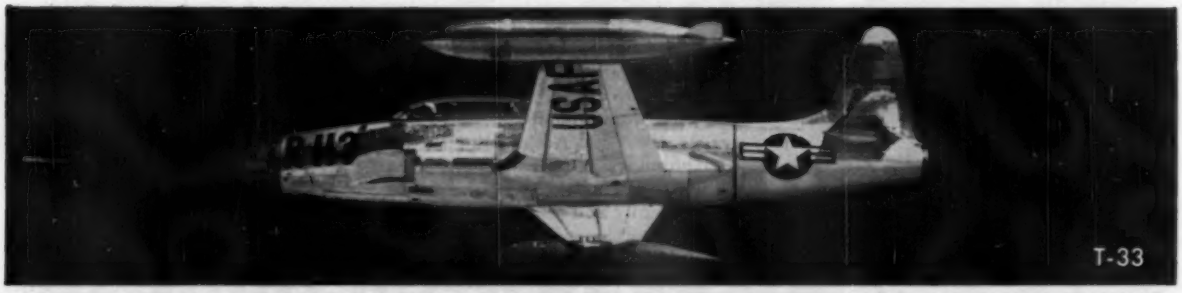
► Hawaiian Airlines and Aloha Airline (Trans Pacific Airlines) have made substantial personnel cutbacks as an economy measure because of a sharp decline in tourist travel thus far this year. Decline is attributed by officials of the two airlines to the U.S. recession and a sugar strike which began Feb 1. Hawaiian Airlines has reported a 14% drop in inter-island traffic during the first quarter of 1958 as compared with the same period of last year.

► **Aeroflot, Russia's state-owned airline, is complaining that some of its subdivisions continue to schedule their pilots for more than 80-85 hr. of flying monthly, "thus creating excessive work strain." The Russian carrier also has denounced the practice of "short-changing" pilots on their days off. This happens when unavoidable delays prevent flight crews from reaching their home base in time to start their days off at the designated time.**

► Vickers Viscount turboprop 810 reached a speed of 500 mph. in shallow dive during a recent performance test. Purpose of the dive was to test elevator and aileron responses at speeds beyond normal operating limits of the aircraft.

► **Southern Transcontinental Route Case will not develop into a general east-west route case but will be confined to routes from the southeast to the West Coast, according to Civil Aeronautics Board Examiner Edward Stodola. In the prehearing conference on the case, Stodola also ruled that no applications from local service carriers will be heard. Total of 16 trunkline, local service and supplemental carriers have applied for either routes or intervention.**

Only Lockheed has 3 jet trainers in production: the USAF T-33, in which 9-out-of-10 U.S. jet pilots were trained; the T2V-1, U.S. Navy's first carrier-based jet trainer; and the tandem-seat trainer version of the F-104 STARFIGHTER—world's fastest, highest-flying jet aircraft.



T-33

T2V-1

F-104B

Present military thinking indicates that supersonic manned combat aircraft will continue to play a vital role in our U.S. defense plans for as far as we can now foresee into the Space Age. Because this is true, there will be an accompanying need to train pilots and crews for these aircraft, and to maintain their proficiency at high levels.

The low cost two-seat F-104B STARFIGHTER is the world's fastest, highest-flying operational jet trainer plane—ideally suited for the training of U.S. Air Force Space Age pilots of the future, to whom supersonic speeds and stratospheric flights will be daily routine.

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AIRBORNE EARLY-WARNING AIRCRAFT • ANTI-SUBMARINE PATROL PLANES

Runway Will Double Idlewild IFR Traffic

New York—Instrument weather capacity of New York International Airport will be more than doubled next year when the airport's new instrument runway is commissioned, the Port of New York Authority predicts. The planned 8,400-ft. strip, parallel to existing Instrument Runway 4-22, is now in the surcharge stage of construction.

New 4R-22L, or V prime as it is called, will incorporate such modern aids as bi-directional instrument landing systems, flush lighting, and high speed turnoffs. Under the proposed system, with V prime handling all instrument landings and the present runway used for takeoffs, capacity is estimated at 100 aircraft movements an hour. These include 60 takeoffs and 40 landings. Capacity now is between 35 and 40 instrument movements an hour.

Site of the new strip is outboard of present 4-22 in relation to Idlewild's terminal area. The runways are separated laterally by 3,000 ft., ample room in case of a missed approach in the Port Authority's view. Outboard runway will be used for landings because it entails less interference from crossing traffic than the inboard strip.

Chief limiting factor of airport capacity is the acceptance rate of the landing runway, so delays to takeoffs from the inboard strip will be less important than landing delays would be. Another reason for the arrangement is the shorter taxiing distance for departing aircraft, whose fuel consumption is more critical than that of arriving aircraft once they are on the ground.

Further, if the Port Authority had decided to make the existing strip the landing instead of takeoff runway, installation of some of the new features would be more difficult than building them into the new layout.

These features include:

• **Flush narrow gauge** runway lights with flush centerline lights beyond the narrow gauge units. Taxiway exit centerline lights also will be of the flush type. Conventional runway edge lights will be spaced 100 ft. apart, as at Newark Airport, although Civil Aeronautics Administration standards are satisfied with a 200-ft. interval. Taxiway side lighting will be of the blue columnar type developed by Port Authority and already in use at its airports. High intensity approach lights and condenser discharge flashers will be installed at both ends of the new runway. These units will be moved from 4-22 to serve the new landing runway.

• **Navigation aids** will include bi-directional ILS, already in operation on 4-22. Transmissometer and ceilometer equipment for end-of-runway weather observation will be installed at least at one end.

• **High speed turnoffs,** if present plans materialize, will begin about 3,450 ft. from each threshold. Another will be located at 5,850 ft., and a third at 4,650 ft. later on if experience shows a need for it. Exit speeds up to 60 kt. are expected to be possible. Radius of turn on the centerline is 1,800 ft. through an angle of 30 deg.

Traffic at Idlewild last year totaled 5,193,023 passengers, up 15.7% from 1956. For all Port Authority airports—Idlewild, La Guardia, Newark and Teterboro—the total for 1958 was 13,441,382 passengers, an increase of 11%.

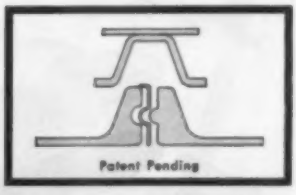
Resort Airlines' Revenue Increases

Washington—Resort Airlines, terming itself country's largest contract carrier of military air freight, earned $7,381,891 in gross cargo and passenger revenues last year, the carrier reports. Total represents a 20.4% increase over 1956. Net income was $596,508 compared with $572,995 in 1956.

Net for first four months of 1958 shows a $100,000 increase over all of 1957, the company said. This year's income includes a $500,000 profit from "assisting others in sale of their aircraft."

Cutaway view of AWICA "B" seal

EXTREME TEMPERATURES AND PRESSURES CALL FOR AWICA "B" SEALS



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Specifications: Successfully tested for 1000 psi at 1000 degrees F. on small sizes.

Standard sizes from 1" to 12" — special diameters to your requirements.

AWICA — for use in aircraft and missile systems and industrial fields as a compact, lightweight, low-cost joint.

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AWICA "B" Seal, with exclusive positioning lip, snaps to flange. Double contact is made as joint is completed to assure a positive seal that is vibrationproof, even under extreme conditions.

Additional advantages are:

- *Easy assembly of entire joint*
- *Positive indexing, seal positions automatically*
- *Repeated connect and disconnect do not damage seal*
- *Perfect for joining dissimilar materials*

Clamping methods are designed for a low torque value to prevent shearing of bolt. Patented "hook bolt" feature provides superior holding strength and simplifies installation in restricted areas.

AWICA Clamps, couplings and straps manufactured by

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POWERED BY 4 ROLLS-ROYCE GAS TURBINE ENGINES

CONTINENTAL AIRLINES

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NEW JET POWER VISCOUNT II

MAKES WORLD PREMIERE ON CONTINENTAL AIRLINES SERVING

CHICAGO, KANSAS CITY, COLORADO SPRINGS, DENVER AND LOS ANGELES

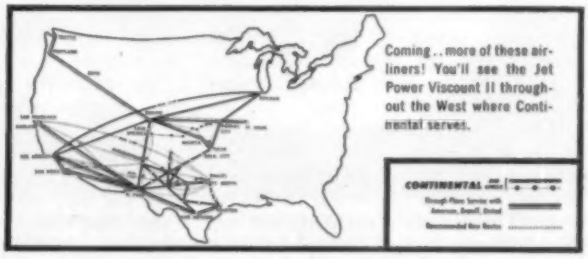
On May 28th at 8:00 A.M. the first commercial jet-power airliner ever to leave Chicago for the West will streak down the runway and head for Los Angeles.

The Jet Power Viscount II will be making its world premiere with this initial jet-power flight to the West. These 56-seat luxury airliners are custom-built for Continental by Vickers-Armstrongs Limited. Rolls-Royce builds the 4 gas turbine engines. This is the newest and fastest airliner in America and *you'll see, hear and feel the difference!*

For example, you'll be amazed at the comparative silence and smoothness of your flight. You'll enjoy the view from the large, oval picture windows. You'll relax in the reclining king-size easy chairs and appreciate the convenience of having your own fold-away table. There is a front compartment and a pleasant rear lounge. The decor is restful and luxurious. Temperature is automatically controlled and the cabins are fully pressurized. Radar, of course.

And to make your flight completely enjoyable, there is Continental's famed "Gold Carpet" Service. This special kind of personal and considerate hospitality includes Golden Buffet Breakfasts, Golden Champagne Dinners and Luncheons. At dinner and luncheon time, Golden Champagne is complimentary. Cocktails are available at moderate cost.

Make reservations now. Phone or write any Continental Airlines ticket office or see your Travel Agent.


Coming... more of these airliners! You'll see the Jet Power Viscount II throughout the West where Continental serves.
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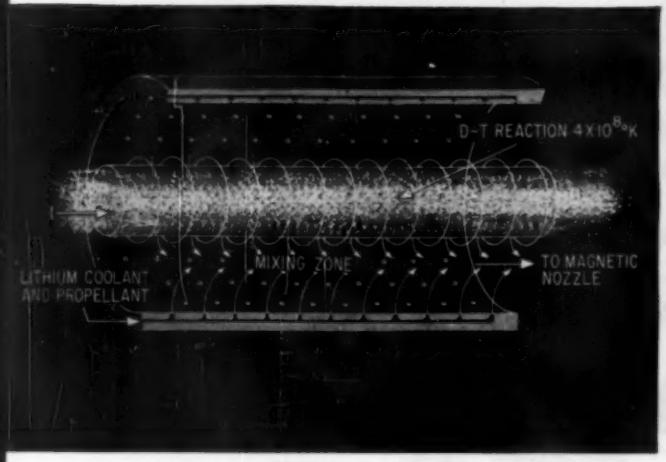
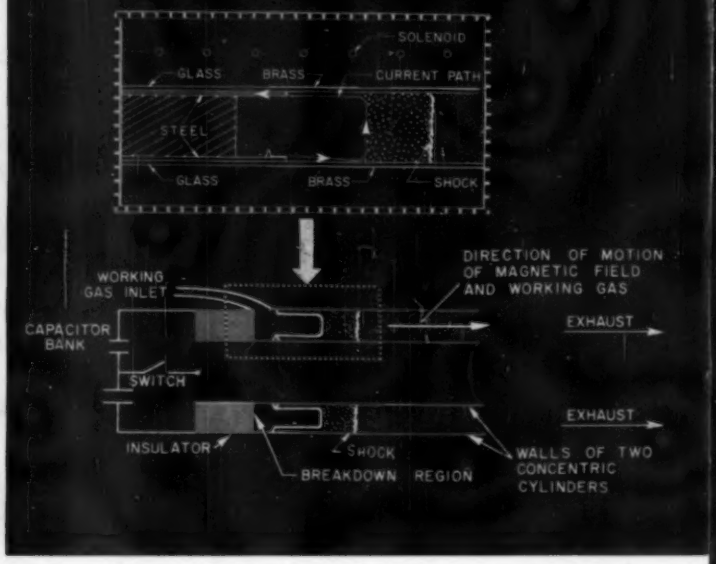




COMBUSTION chamber for fusion-powered rocket engine (left) suggested by M. U. Clauser would have lithium coolant swirling around the reaction to form a heavy exhaust plasma to produce thousands of pounds of thrust with a specific impulse of more than 3,000 sec. It is believed such engines can simultaneously produce thrust and the electrical power they need to operate. Two other types of engines which accelerate ionized gases with electric and magnetic fields are theoretically possible today. The

Magnetohydrodynamics: Part II

Controlled Fusion Studies Open Space

By J. S. Butz, Jr.

Washington—Hope of achieving a controlled thermonuclear reaction within a few years is opening a powerplant field of great potential which offers the prospect of combining great thrust, high specific impulse, and low weight into a single unit. Essentially, it would answer the propulsion question for effective space vehicles.

At the same time, however, it threatens the timing of any overall development program for practical space vehicle powerplants. Propulsion schemes such as fission rockets, ionic engines and magnetic accelerators which offer certain significant performance increases over chemical systems will require a number of years to perfect. If a maximum effort was initiated now to develop the most promising of these it is entirely possible that new knowledge of magnetohydrodynamics, which is the key to controlled fusion, would have made the whole program obsolete before any hardware was produced.

The shock that rapid increases in knowledge have been giving fiscal and managerial personnel in the government for the past 15 years could reach a peak with the early accomplishment of controlled fusion.

A great deal of money has been spent on fission powerplants of several types including rockets in Project Rover and auxiliary units for flight use in Project Snap. These units when perfected and the stationary fission powerplants now in operation and planned were expected to be useful and amortized over a considerable period of time.

However, the prospect that a vastly more efficient power system might be available in the next 10 years or so and might even become a parallel development with the fission units cannot be discounted any longer. This is evidenced by the announcements of the Atomic Energy Commission which is certainly conservative in its releases.

Controlled Fusion

A year ago the AEC spoke of controlled fusion as being a hope of the rather distant future. This position has become more optimistic. American laboratories feel that the controlled and sustained thermo-nuclear reaction would be achieved within a few years although it might not produce net power.

The main advantages offered by thermonuclear powerplants of all kinds are that their main fuel, deuterium, is contained in sea water in almost inexhaustible quantities, their temperature and efficiency is not limited by the usable temperature of present materials as in fusion reactors and they do not have the radioactive waste disposal problems.

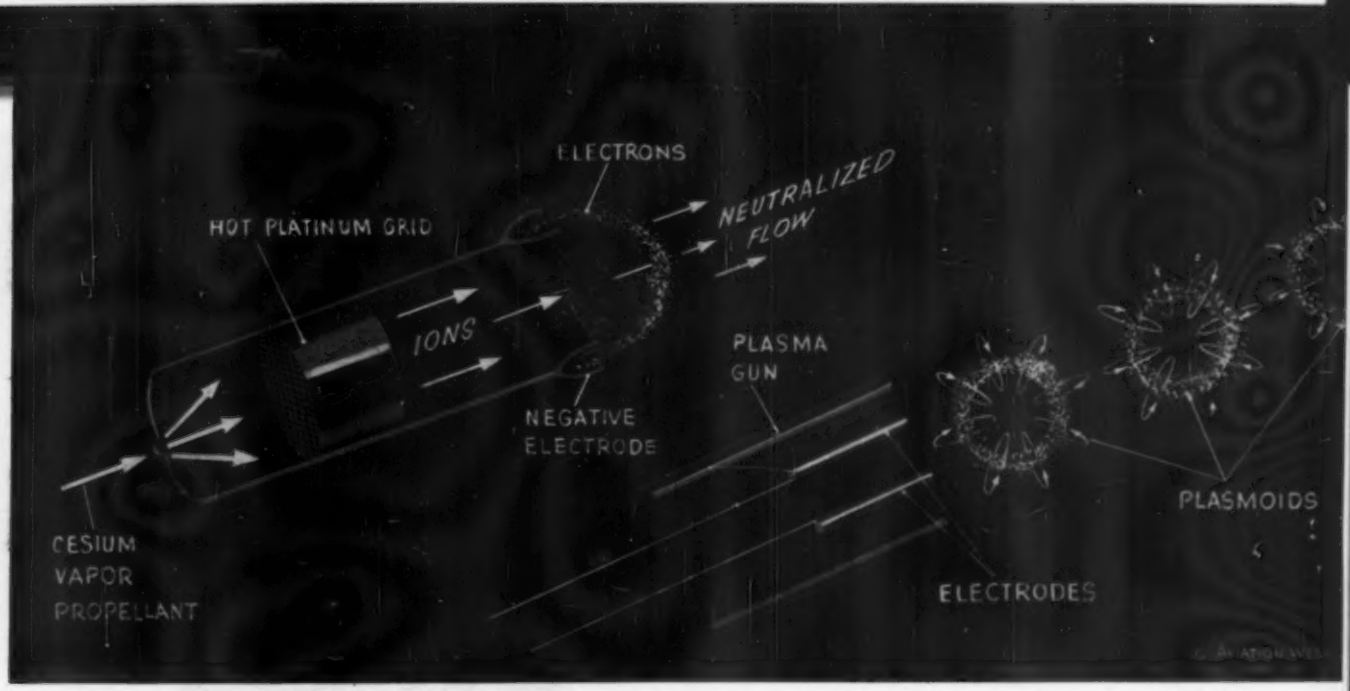
As specifically applied to the propulsion of space vehicles, there is considerable hope that the fusion engine will eliminate the heavy turbine-generator electrical system which handicaps present ion and plasma engine proposals. And that these engines will produce their own electrical power directly at the same time that they produce thrust.

The specific impulse of such fusion engines theoretically can approach 2-3 million sec., but at very low thrust ratings. Gases injected into the combustion products however can be vaporized to increase the exhaust weight and provide thrusts high enough for one "G" accelerations or better for the payloads now deemed necessary for interplanetary flight. The specific impulse in this instance has been estimated to be between 3-4000 sec.

Such fusion engines would allow take-off from the surface of the earth, landings on the planets, return landings on the earth with a comfortable power margin which would allow corrections for errors in navigation and numerous other miscalculations that are possible during the journey.

Powerplants of this general nature have been discussed at some length by R. W. Bussard of Princeton University, R. D. DeLauer, Naval Air Weapons Facility, Kirtland AFB, N. M., and M. U. Clauser of Ramo-Wooldridge Corp. Other workers in the atomic energy field have generally outlined the problems and promise of fusion rockets in published papers, and they are generally considered to be the current "ultimate" in reaction powerplants. If and when the sustained and controlled thermonuclear reaction is achieved these rockets presumably developed rapidly.

Probably the most complete discussion available on the fusion rocket was given by Dr. Clauser of Ramo-Wool-



Avco magnetic accelerator which expels a high velocity neutrally charged plasma (left center) and the Stuhlinger ion engine (right center) which accelerates positive ions with an electric field. These provide high specific impulse and low thrust and need heavy generators to produce electric power. Apparatus in use by W. M. Bostick (right) could be classed as forerunner of solid fuel plasma engines. Electrodes are titanium impregnated with deuterium ions; the doughnut plasmoids produced can be accelerated.

Engine Field

dridge at the recent conference on extremely high temperatures at the Air Force Cambridge Research Center.

Dr. Clauser believes that deuterium-tritium will probably be used as the reactor fuel because their fusion reaction will sustain itself at the lowest temperature.

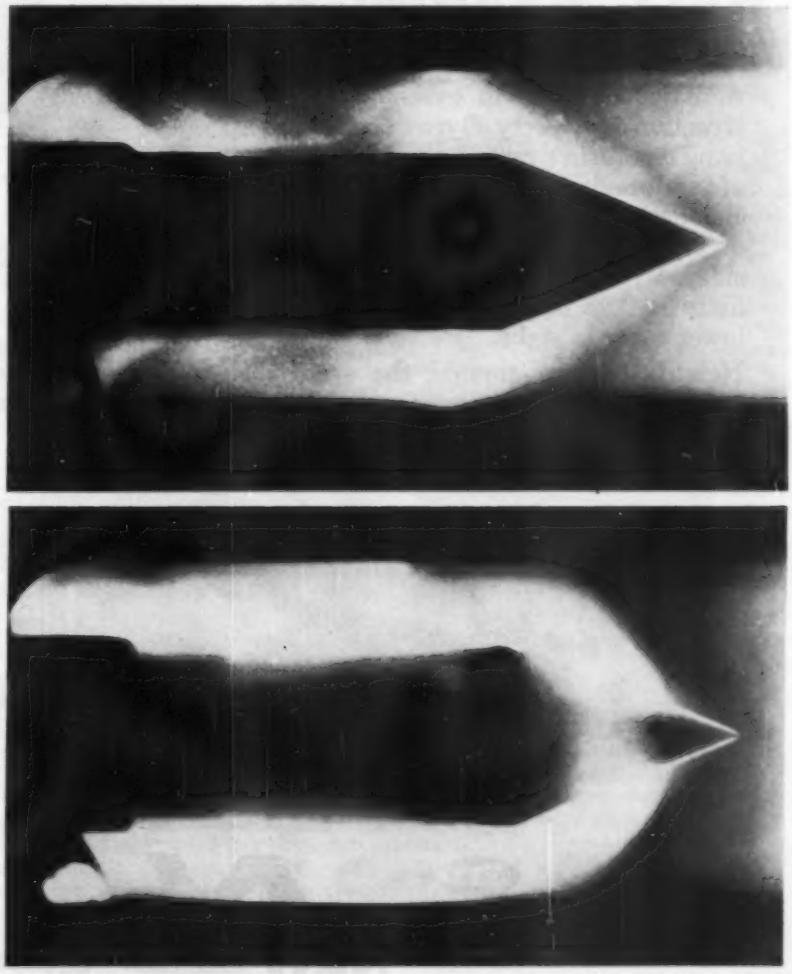
He also indicates that the pinch method of confining the reaction will probably will not be satisfactory for reaching a sustained fusion if used alone. The stabilizing fields required for a stable pinch would prevent the pinching field from attaining the compression needed.

Shock Heating

Clauser said that Ramo-Wooldridge is working on a method of shock heating which might make it possible to avoid these difficulties. His method of shock heating is evidently similar to the procedure described last week which is in use at the Naval Research Laboratory.

If this scheme or some other is able to sustain a fusion reaction then Clauser visualizes the reaction plasma as ultimately held in the form of a cylindrical column contained by a magnetic field created by a current passing through it. The stabilization would come from some source outside of the reaction region which would correspond to the combustion chamber of a chemical rocket.

One main problem with this type of power is that the radiation from the



QUALITATIVE test of magnetohydrodynamic boundary layer control by Avco shows shock wave slightly displaced forward (bottom) when current is passed through coils wound around nose of test shape. This would indicate reduction in heat transfer and increase in form drag.

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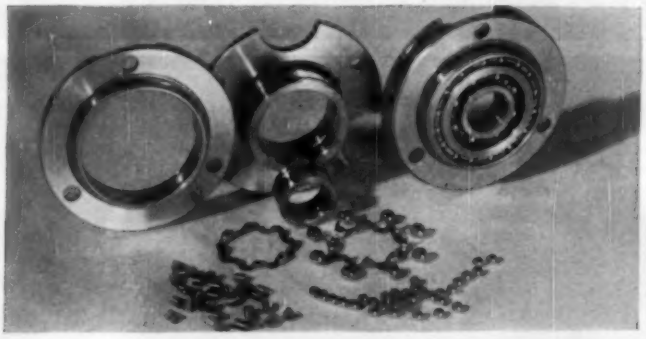
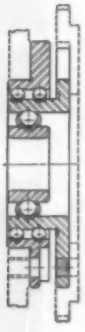
1200% GAIN IN GYRO ACCURACY WITH NEW DEPARTURE BALL BEARINGS!

Sperry C-11 Gyrosyn® Compass with Rotorace bearings will give ultra-precise navigation to the new jetliners.

A major advance in gyroscope construction by Sperry Gyroscope Company results in a remarkable reduction of random drift rate. Involving a special design of gimbal bearings, rates of 2 to 3 deg. per hour, recently considered very good, are now cut to as little as 0.25 deg. per hour with still lower rates in sight.

New Departure created the special manufacturing techniques for the high-precision production of unique ball bearings—another indication of New Departure's ability to meet exacting instrument bearing requirements thru wide engineering experience and precision manufacturing facilities.





The Sperry Rotorace (TM) Gyroscope employs two bearings, one concentric within the other. One outer race is fixed to the gimbal frame, while the other carries a light gear by which it is rotated in periodically alternating directions.

In addition to reducing random drift due to any microscopic irregularities or possible foreign particles, rotation of the bearing race also reduces bearing static or break-away friction.

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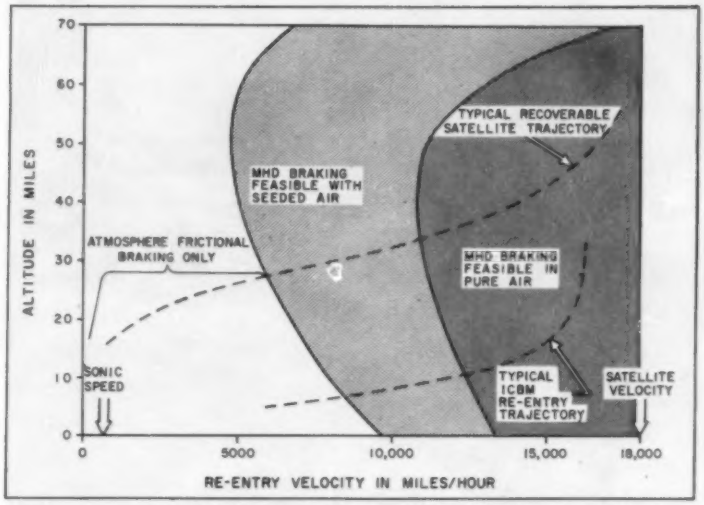
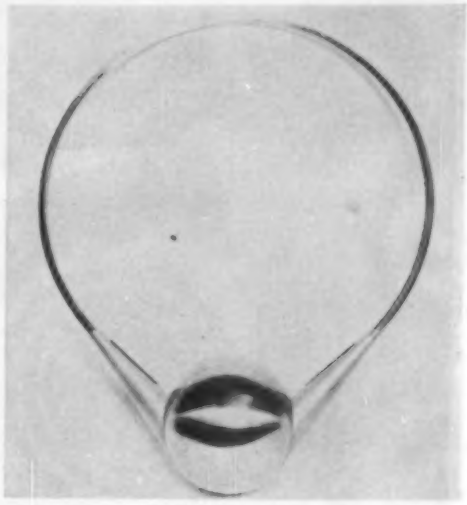
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL





AVCO re-entry vehicle would have current passed through ring behind sphere housing the crew. Field produced by current would slow ionized air passing around the sphere. Seeding the air with Sodium could maintain the ionization and braking effect at lower speeds.

reactor will heat any structure it strikes. Clauser estimates that the heat that will have to be dissipated amounts to about 1/30 of the charged particle if the propellant tanks and structure of the rocket are of about the same cross section as today's large rockets. He also estimates that if he has made an error in the amount of heat to be dissipated by a factor of 2 or 3 the situation does not change radically.

Lithium Circulation

To dispose of this 3% power which must be dissipated, lithium would be circulated through the structure. Lithium absorbs a reasonably high quantity of heat through vaporization and its boiling point is below the melting temperature of structural materials such as titanium. This vaporized lithium then passes out of the coolant space between the outer and inner walls of the reactor and is swirled around the inside of the chamber between the inner wall and the reaction zone. Hot charged particles from the reaction zone diffusing out through the magnetic field will mix with the incoming lithium vapor and the temperature of the combination will reach what is called the propellant temperature.

This mixture of lithium and the reaction product would then have to be led off through a magnetic nozzle and most of its thermal motion converted into jet or streaming motion.

The actual shape of the combustion chamber would be a torus and any pinching current would be induced to avoid putting large amounts of current through metal return leads.

Probably the most important question to be answered about the fusion engine for space vehicle propulsion is how will the electrical power for the stabilizing and compressing magnetic fields be provided. There are several ideas for obtaining this power without using the customary heat exchanger-turbine-generator equipment.

If any of them are successful the size of the fusion powered space vehicle could probably be reduced by one order of magnitude.

In general these ideas involve setting up some type of oscillation during which the stabilizing magnetic field pressure and the kinetic pressure of the reaction products would alternately dominate.

When the magnetic pressure was higher the reaction temperature would be raised and when the kinetic pressure of the reaction products was higher the magnetic field would be pushed back and electric power could be stored in an external circuit.

Another of these ideas that might prove useful is discussed later in this article when an ionized gas pocket is driven through a magnetic field cutting the magnetic lines of force inducing a current and power is stored in an external circuit.

With such an oscillating pressure it would be possible to produce thrust and electric power directly with the same reaction without generating equipment.

Dr. Clauser's paper on the fusion rocket was predicated on the idea that the sustained and controlled thermonuclear reaction proved possible. His description of the actual engine was only a suggestion of how it might conceivably function. Other ideas are equally applicable to such an engine. Dr. Clauser did indicate that he felt that once sustained fusion was a reality there was no other fundamental obstacle to the engine he described.

Several other reaction powerplants which rely on an interaction between magnetic and electric fields and ionized gases to generate thrust have been proposed. R. M. Patrick of the Avco Research Laboratory has delivered a paper on a magnetic accelerator which produces thrust by discharging a neutral plasma. Kurt Stuhlinger proposed an ion engine a number of years ago which would accelerate a stream of ions with an electric field or a moving magnetic field. This type of engine was believed to have been suggested for the first time in the 1920's by Hermann Oberth.

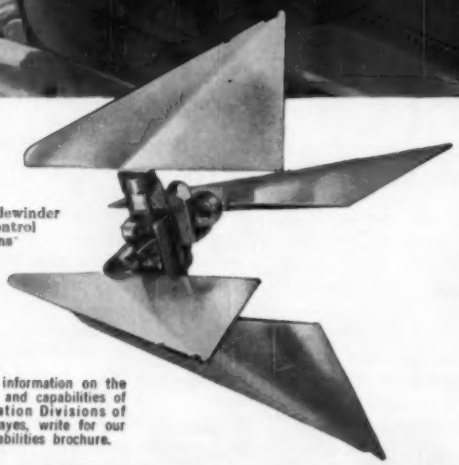
Gas Plasma

An electric arc also has been used to create and accelerate an ionized gas plasma.

The Russians during 1955 reported experiments in which plasma temperatures of 90,000 deg. R were reached, corresponding to a specific impulse of 10 times those obtained today from liquid chemicals. General Electric, Giannini, Avco and the National Advisory Committee for Aeronautics in this country have worked with these devices for testing materials at high temperatures as well as the possibility of using them for propulsion.

Although these engines in general offer an order of magnitude increase in specific impulse over chemical fuels, they require a large amount of electric power.

Under the schemes that are presently being pursued, this electrical power would be supplied by a fission reactor or solar energy. Heat from these sources would have to be transferred to a working fluid which would then drive a turbine that would in turn drive a generator. A system for delivering this type



Sidewinder Control Fins

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sidewinder...

a deadly new fang for Naval Jets!

The Navy's new self-guided, air-to-air missile, "Sidewinder," is so accurate that it can "home" in on and hit the tailpipe of a supersonic jet engaged in violent evasive action. Control fins for this deadly new missile are produced by the Aviation Divisions of Kelsey-Hayes Co., Detroit 32, Michigan.

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of power from a small fission reactor is part of Project Snap. While considerable progress has no doubt been made in reducing the weight of the equipment it could never be completely eliminated.

Space vehicles which used systems requiring this electrical generating equipment will probably show an improvement over chemical rockets so far as vehicle size for a given flight is concerned. The advantage of the system would be that refueling for a second trip would be relatively cheap because the fuel weight required would be only 5% to 10% of a chemical fuel rocket. As this fuel would have to be taken from the earth to a resupply orbit, the ion or plasma engine probably would become more economical on the second trip.

Another disadvantage of these low thrust, high specific impulse engines is that their low acceleration would not let them land and take off from the surface of the moon or any of the planets.

The combustion chamber for Stuhlinger's ion engine proposal is shown on page 51. The NACA is actively working with scale models of such ion engines in an effort to get the optimum configuration. The combustion chamber is the problem area and, once it works properly, it would be mated with a lightweight generating system from Project Snap and propellant tankage and be ready for use.

The combustion chamber operates approximately as follows: cesium vapor propellant is sprayed into the chamber and passed through a heated platinum grid which ionizes the cesium. The positive ions are attracted toward the chamber exit by negative electrodes and accelerated out of the chamber providing thrust. To keep a cloud of positive ions from building up behind the chamber and creating a back pressure by repelling the positive charges being emitted, the ions must be neutralized as soon as possible after they leave the engine. It also is necessary to keep the vehicle from becoming charged by accepting the electrons liberated during the ionization. The electrons are then collected at the hot-platinum grid and used to keep the negative electrodes at the existing charge. The electrons then pass from these electrodes and are attracted to the existing ion stream, providing a neutral flow again and relieving back pressure on the chamber.

Combustion Chamber Size

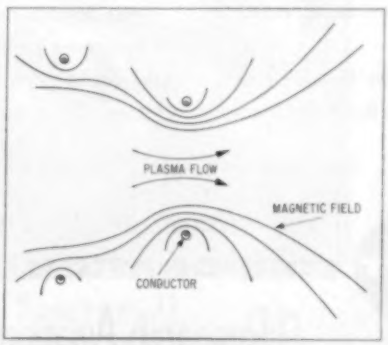
An idea of the relative size of the combustion chambers and the equipment used to provide the electrical power for the engine can be gained from a recent statement by Dr. Hugh L. Dryden, director of the NACA. When the NACA was showing a group of visitors an experimental ion engine and some were impressed by the small size of the "combustion" chamber that was enclosed in an evacuated bell jar, Dr. Dryden told them the other part of the engine was literally the Potomac Light and Power Co.

A proposal for a device that accelerates a neutrally charged plasma with a magnetic field has been made by Avco Research Laboratory. This engine has been described in a paper by R. M. Patrick. One advantage which is competitive with Stuhlinger-type electrostatic engine is that the problem of separating the ions is eliminated.

This engine is shown on page 50; its operating cycle is briefly as follows: a uniform shock wave is formed by discharging a large capacitor into the gas filled cavity between two concentric tubes; an electric field is created by closing the switch which interacts with the magnetic field imposed externally by a solenoid to make the initial ionization of the gas uniform; the ionized gas pocket is then driven down the tube behind a shock wave by a force created by the interaction of the external magnetic field and the electric field that exists between the walls of the two tubes which are conducting.

Another type of device that could conceivably be called the forerunner of any solid fuel fusion engine has been experimented with by W. H. Bostick of the Stevens Institute. The original purpose of Dr. Bostick's work was to create an inexpensive means of studying magnetohydrodynamics by producing deuterium ions that would behave as an entity and could be observed as they passed through a magnetic field. To accomplish this, Dr. Bostick constructed a plasma gun that discharged a strong current through two electrodes which are usually made of titanium and impregnated with deuterium ions. He has used various means to accelerate and stabilize these plasma samples or plasmoids and believes a specific impulse of 100,000 sec. is possible.

This type of solid-fuel engine also would require externally supplied electrical power unless a great improvement is possible. The Russians also are working in this field.



PLASMA engines would exhaust through a supersonic magnetic nozzle as current materials could not withstand the temperatures.

As has been mentioned previously, one of the great hopes of controlled thermonuclear reactions is that they will provide electric power directly without the use of generators. The two general methods being proposed are to intercept particles being emitted by the reaction by some type of material that will develop an electrical potential when hit by the particle; the second means is a magnetohydrodynamic one in which there is an interplay, or oscillation, between magnetic fields and ionized gases.

The suggestion that ionized gases be fired through magnetic fields to produce electric power has long been advocated. Present-day shock tubes could be used in this manner to form an MHD generator which would replace the turbine and conventional rotating generator. Arthur Kantrowitz has described such systems and lists among their advantages an absence of moving parts, an ability to operate at much higher temperatures than a turbine and more ease of construction which would make it suited for very large stationary power stations.

This system of having shock waves working against magnetic fields also has been suggested for use with the fission reaction. In a proposal by S. A. Colgate and R. L. Amodt of the University of California Radiation Laboratory and the Los Alamos Scientific Laboratory of the University of California respectively, a fissionable gas is collected in one end of a long tube surrounded by refractory material. The amount of gas and tube geometry is adjusted so that a large temperature rise occurs before the gas spreads a great distance down the tube. This produces a shock wave which travels through the external magnetic field.

Other Applications

Some other practical applications of magnetohydrodynamic principals that have been advanced apply to:

- **Boundary layer control** for aircraft travelling at speeds high enough to partially ionize the air flowing over the aircraft.
- **Providing electrical drag for re-entry** from orbit vehicles.

The boundary layer control ideas have been advanced by personnel of Avco Research Laboratory and Republic Aviation Corp. Qualitative tests of the principle have been conducted at Avco. Photographs of one of the test runs are shown on page 51. No data has been released, but the photographs indicate that the shock wave was displaced forward. Theoretically, this would indicate a decrease in friction drag and heat transfer to the body.

Avco has suggested a re-entry

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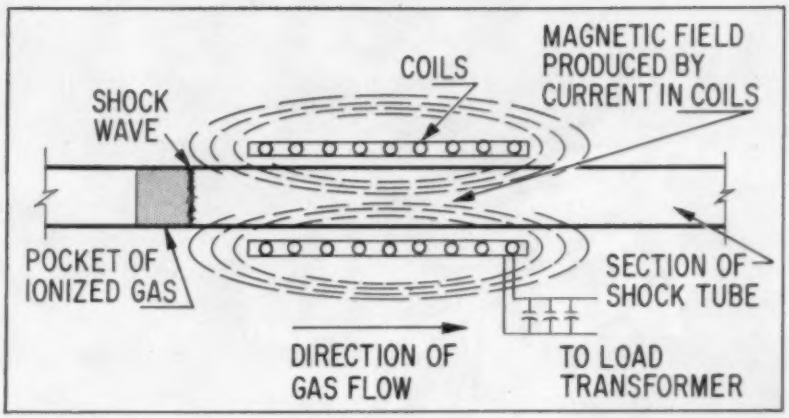
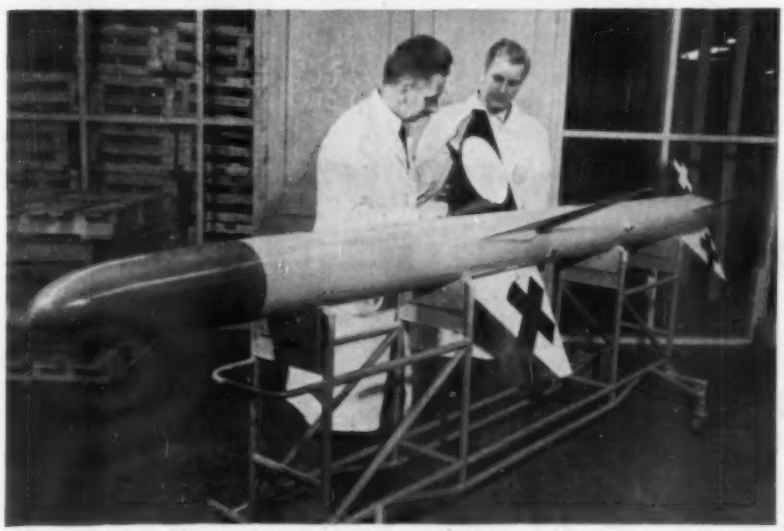


ONE SUGGESTION for magnetohydrodynamic electrical generator with no moving parts would send ionized pockets of gas behind shock waves through a strong magnetic field. Work done by cutting lines of force produces current in external LC circuit. Radiation absorption of ionized air is of interest in the design of warheads for anti-missile missiles.

vehicle that would be partially slowed during its return to earth by an electromagnetic drag force. On this vehicle, a large current is passed through the ring aft of the main spherical body. The magnetic field slows and deflects the ionized air flowing past the vehicle at high Mach numbers and gives it a much larger effective cross-sectional as far as pressure drag calculation is concerned. The shock wave is correspondingly shifted farther forward and reduces heat transfer.

Another factor mentioned by Avco is that a large electric current could be generated by the portion of the ionized air particles which pass through the magnetic field instead of being deflected aside. This current could power various auxiliary equipments during the final descent.

Magnetohydrodynamic studies in several laboratories are being made to determine the absorption qualities of various gases when they are in various states of ionization. This information will be of practical interest to the men who are designing manned and unmanned space vehicles. General results of these studies indicate that at certain speeds in space the air surrounding a vehicle will absorb all of the visibility and it will be impossible to see out of the vehicle or to take television pictures. Certain radio and radar frequencies will also be useless for communicating with or tracking the vehicle because their energy will be absorbed.



Canadair Builds Sparrow II

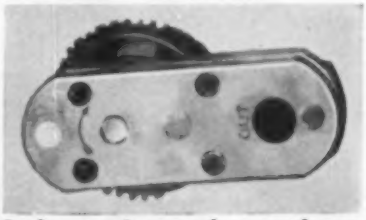
Sparrow II air-to-air missile which Canadair Ltd. will build for the Royal Canadian Air Force differs from Sparrow I in having a rounded instead of pointed nose, truncated tips on forward fins. Douglas Aircraft Co. developed Sparrow II as a solid propellant, experimental missile with a more sophisticated guidance system than Sparrow I.

PUMP PRIMERS

by
Arthur A. Nichols

Special pumps for special materials and unusual problems

One of the problems faced by most competent manufacturers is to let people know just what to expect from their equipment. Designers find it difficult to keep in mind more than a general idea of the ultimate capabilities of the many and varied types of components with which they construct sub-assemblies or systems.



In the case of pumps, for example, our development and research people are constantly working out ways to handle the newer materials. Many times the results are surprisingly good for materials most equipment designers would not readily attempt to pump in the first place.

In over thirty years experience in the design and manufacture of special pumps, we have solved numerous pumping problems where the design and production of a suitable pump was considered almost impossible, either because of the material to be pumped, or because of the precise manufacture necessary to obtain satisfactory performance.

Nichols pumps are standard for example, in the synthetic fibre industry for pumping rayon, acetate, celanese, nylon and other fibres spun in synthetic fibre plants throughout the world.

Special pumps have been designed and manufactured for applications as varied as metering pumps in vending machines and conveying molten solder in production equipment. This long and varied experience in industry-wide pumping applications, combined with years of specialized development and production of pumps for the aircraft engine, super-charger, missile, helicopter and electronic field is available to today's designer faced with new and unusual pumping applications and problems.

If you have a pumping problem — no matter how difficult or unusual — we invite you to send it along for our analysis. We'll be glad to tell you whether we think we can be of help.

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HOW MODERN **T58** *POWERPLANT DESIGN PROVIDES . . .*

Payload Superiority, Greater Flight Endurance and Range

GENERAL ELECTRIC T58 REFLECTS LATEST PROGRESS IN POWERPLANT STATE-OF-THE-ART

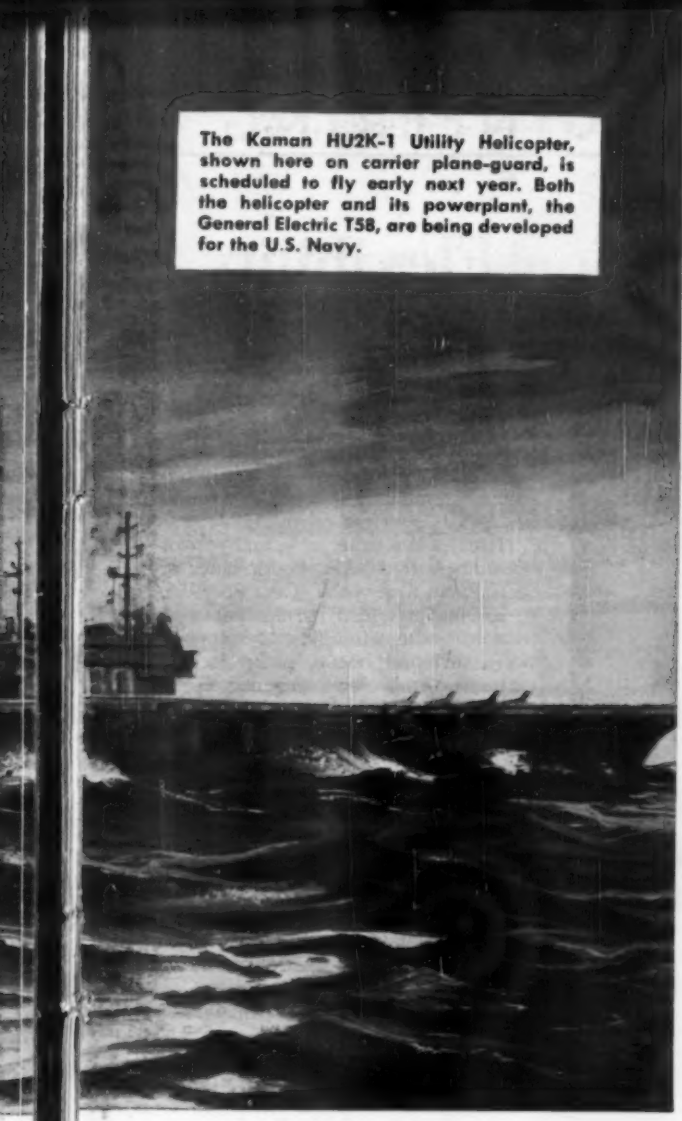
T58's light weight and low SFC offer helicopters the low installed weight and minimum fuel consumption vital to payload superiority, increased flight endurance and longer range. The story behind this modern powerplant design? Thoroughly-tested gas turbine design concepts applied to all major T58 components. For example . . .

Small, compact axial-flow compressor—modern aerodynamic design uses fewer compressor stages to achieve maximum operating efficiency . . . fewer parts increase reliability, reduce total engine weight.

Short, small-diameter annular combustor—modern combustion design provides higher burner efficiency, longer life, simplicity and light weight.

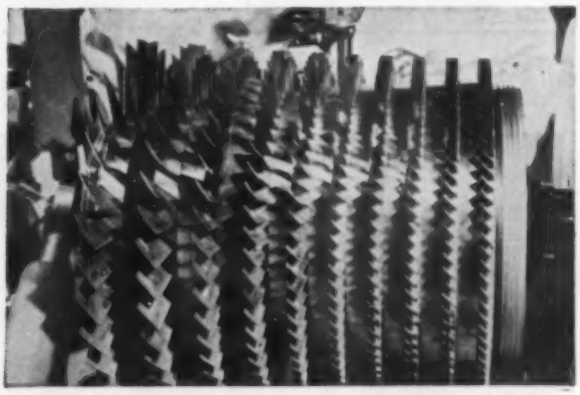
Lightweight gas-generator turbine—two-stage, axial-flow turbine features short-chord turbine buckets which cut turbine weight, yet retain ability to absorb punishment.

Proven concepts? ***Last Fall, the T58 passed its official Model Test—without deviations—thus becoming this nation's first 150-hour qualified gas turbine engine specifically designed for helicopters*** . . . In addition, since early last year, twin T58's have been undergoing intensive flight testing in the Sikorsky HSS-1 and, later last year, aboard the Vertol H-21D . . . For new T58 technical information brochure, write to: General Electric Co., Section 233-14, Schenectady 5, N. Y.



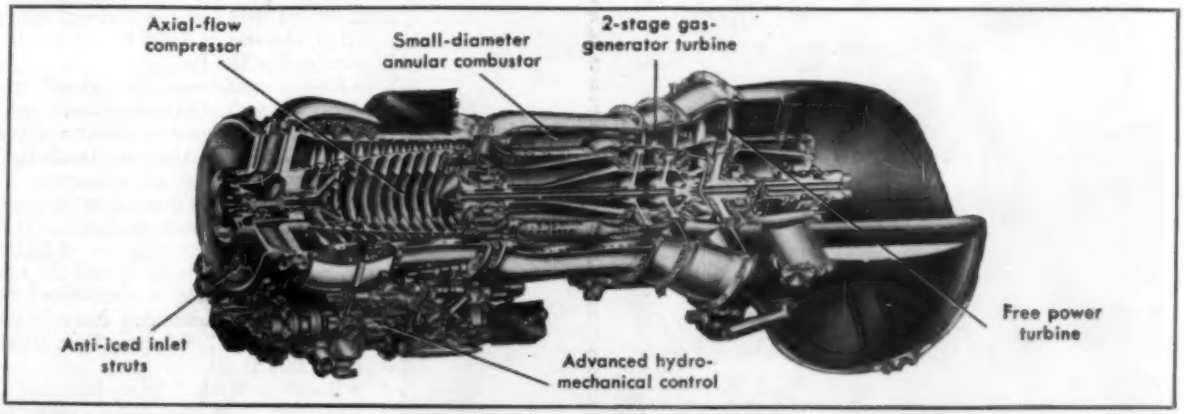
The Kaman HU2K-1 Utility Helicopter, shown here on carrier plane-guard, is scheduled to fly early next year. Both the helicopter and its powerplant, the General Electric T58, are being developed for the U.S. Navy.

Typical Components of Modern T58 Design Help Insure Superior Mission Performance



One-piece steel construction of last eight stages of the 10-stage compressor rotor hub provides ruggedness, dimensional stability.

Durable combustion liners have survived 150-hour Model Test without trace of deterioration . . . combustor's altitude re-start ability proven.



Production T58's will deliver 1050 hp, weigh only 267 lbs, not including 75-lb optional reduction gear and will burn JP-4 or JP-5 fuel. Almost 4 to 1 power-to-weight ratio, 0.64 SFC guarantees are practical expressions of modern design principles and development techniques that reflect progress in powerplant state-of-the-art.

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GENERAL ELECTRIC

Aviation Week Pilot Report

C-130 Demonstrates Mission Flexibility

ALLISON T56-A-1A turboprops with 3-bladed propellers power Lockheed G-130As (above). T56-A-7As with 4-bladed propellers (below) will be 10 in. further forward on C-130B.

By Robert I. Stanfield

Marietta, Ga.—Operational flexibility of Lockheed's powerful 62-ton, pressurized C-130A Hercules, with its four constant speed Allison T-56-A-1A turboprop engines, is evidenced in its flight characteristics, general ease of air-ground handling, and all-field capabilities at varied weight regimes.

Hercules is now in its second year of operation with USAF. Performance of versatile airplane (AW Dec. 3, 1956, p. 50) has expanded its mission range from troop-cargo transport to mapping, ski, search and rescue, tanker, reconnaissance, drone launching and escort operations. Additions are in the works.

Flight evaluation by AVIATION WEEK pointed up these key features:

• **Turboprop power.** Each engine generates 3,750 eshp. at takeoff, 3,375 eshp. normal. Three-blade Aeroproducts electro hydraulic propeller—full feathering, reversible pitch—changes pitch 17 deg. per second. At 20,000 ft., with two outboards feathered, 360 mph. airplane indicated 200 kt. under normal rated power. Stability and control was excellent.

• **Short-field capability.** Normal takeoff, into 70 deg. crosswind at 8 kt., 14C outside air temperature, was made with 50% flaps. Hercules was airborne within 1,700 ft. Normal full-flap landing used less than 2,000 ft. of runway. Airplane can operate into and out of a 2,700 ft. strip, or into and out over a 50 ft. obstacle in 4,000 ft., on standard day, at 124,200 lb.

• **Fast acceleration.** On takeoff, and during airwork, Hercules showed quick and precise response to power and control applications. Airplane literally leaps ahead with sudden power increase.

• **Rate of climb.** Grossing out at about 90,000 lb. on takeoff, we had 3,500 ft. of altitude when passing end of 10,000 ft. runway. Climb to 10,000 ft. took 3 min. 30 sec. Rate of climb was 3,000 fpm. Airplane ascended from 20,000 to 25,000 ft. at 2,200 fpm.; from 30,000 to 35,000 ft. at 500 fpm.

• **Boost controls.** Easy handling is result of hydraulic boost assemblies for ailerons, elevator and rudder. Actuation pressure is supplied by booster and utility systems. Spring-loaded switches actuate electrically powered trim tabs. Typical comment: "It's a freight train that handles like a fighter."

AVIATION WEEK evaluation covered two flights in C-130A No. 70458 at

LOCKHEED Hercules takes off. Gear action mechanically governs nose gear doors. Main gear is moved hydraulically in tracks.

all altitudes up to 35,000 ft. Flying time totaled 6 hr. 30 min.

Split crews, from Lockheed Aircraft Corp. engineering flight test section, were pilots Homer Blalock, Jesse Allen and Glenn Gray; chief systems engineer Bob Brennan; flight engineer R. "Skip" Schaper; flight test engineers W. MacReynolds, John Ackerman and Al Kascak.

Hercules is no misnomer. Airplane looks rugged, yet neat. Fuselage undersurface sweeps sharply up toward high tail. Under tail, fuselage divides on horizontal line into a door and ramp. Two paratroop doors are located aft of wing, one on each side. Forward of wing, on port side, is huge cargo-crew door.

Main compartment of Hercules totals 4,300 cu. ft. of space. Cargo floor loading is 1,080 lb./sq. ft. For logistics support work C-130A has maximum cargo capacity of 38,800 lb. As a combat transport, payload would run 24,600 lb.

As an assault transport, airplane can carry 92 ground troops or 64 paratroops and equipment. As an ambulance it can carry 74 litters.

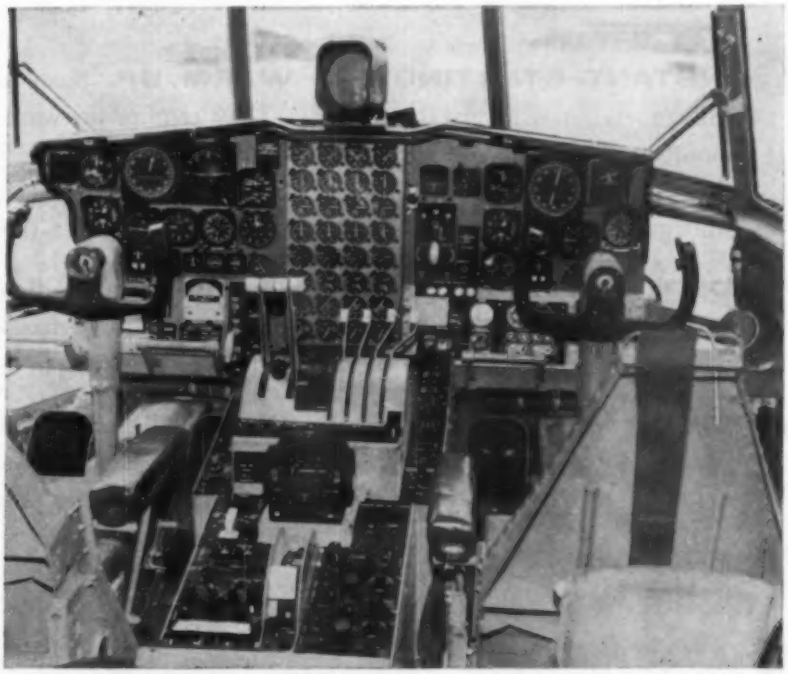
Four lightweight powerplants jut forward from underside of high wing. Each engine has two assemblies, connected by extension shaft and supporting structure.

Power Section

Power section has 14-stage compressor and six through-flow-type combustion chambers which port directly to four-stage turbine.

Reduction gear assembly contains decoupling assembly, propeller brake, engine negative torque control system, necessary gearing to provide 12.5 to 1 reduction in propeller shaft speed. This results in prop speed of 1,106 rpm. at normal engine speed of 13,820 rpm.

Weight to horsepower ratio is 2.5 to 1. Compression ratio is 9.5 to 1. Best per-



LOCKHEED C-130 instruments and flight controls are shown above. Note windshield area. Aviation Week editor Robert Stanfield is below, left, with Lockheed Pilot Glenn Gray.

To Fire Missiles Fast Use Solar Gas Turbines

Compact, reliable gas turbine engines are ideal for missile ground support. Here are the important reasons...

1. **INSTANT STARTING—NO WARM UP.** Solar gas turbines can be started and fully operational in just 10 seconds! They require no warm up... give instant power after months of inactivity, even under severe temperature extremes. This 100% reliability makes them ideally suited for missile support... where every second is of paramount importance! And gas turbines are the *only* prime movers which offer this tremendous advantage.

2. **DEPENDABILITY.** Gas turbines are the simplest of all heat engines. There are few moving parts and no complicated cooling system. Overhauls are infrequent, maintenance is easy, routine servicing can be completed in a few hours.

3. **LIGHT WEIGHT, SMALL SIZE.** Solar gas turbines are many times smaller... and weigh up to *forty times less* than conventional engines! All essential piping and duct components are a part of the engine. There are few accessories and controls.

4. **PORTABILITY.** Compact and lightweight, Solar turbines can be easily mobilized for quick transportation to remote locations.

5. **ADAPTABILITY.** Versatile Solar turbines can provide power for virtually every phase of missile support—such as erecting and aligning, fueling, calibration, checkout and launching. Both shaft power and compressed air are available for important hydraulic, electric, mechanical, and pneumatic applications.

6. **USES ANY FUEL.** Solar gas turbines can operate on almost any available fuel—including gasoline, kerosene, natural or manufactured gas and diesel oil—greatly simplifying logistics for remote missile operations.

Portability, instant power and 100% reliability are continuing problems in the critical area of missile support. For more information on how Solar gas turbines can help solve these problems, write to Dept. F-19, Solar Aircraft Company, San Diego 12, California.

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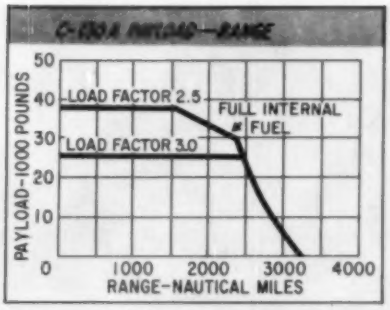

RATIO of C-130A payload to range.

formance—from viewpoint of power output and fuel consumption—would be at speeds from 250 to 480 kt. above 20,000 ft.

Airplane was entered through crew door located forward on port side of fuselage. Roomy flight deck has operational seating for crew of four: pilot, copilot, flight engineer and navigator. Engineer is seated in center of flight station, behind pilot and copilot. Navigator sits behind copilot on right side, facing outboard.

Crew seating is comfortable, even with back parachutes worn throughout flight. Wide Nesa-glass windshield, with lower curved panels for viewing drop zone, gives excellent visibility. Window area totals nearly 40 sq. ft. Main instrument panel mounts flight instruments in front of pilot and copilot; engine instruments center. AN/APN-59 weather radar indicator sits on top of panel, center. Radar is housed in Pinocchio nose.

Cockpit Instruments

Pilot's instruments include compasses, air speed and attitude indicators, altimeters, course and vertical velocity indicators, fuel flow gage, turn and bank, clock, rudder-aileron-elevator trim position indicators, instrument lights control, air diverter handle, marker beacon switch, and omni.

Bottom of copilot's panel includes hydraulic control panel.

Centered engine instruments include torquemeter, tachometer, turbine inlet temperature indicator, temperature and pressure gages, oil quantity gage.

Control pedestal sits below and in front of engine instruments, between pilots. On pedestal are throttles, engine condition levers, electronic prop governor, autopilot controller, flap lever, radio compass filters. Installation includes panels for liaison radio control, UHF, VHF, intercommunications, aerial delivery system controls, trim tabs, radio compass, landing lights, and temperature datum control valve switch.

Overhead panel includes controls for air conditioning, electrical system, fire emergency, engine starting, fuel. Sche-

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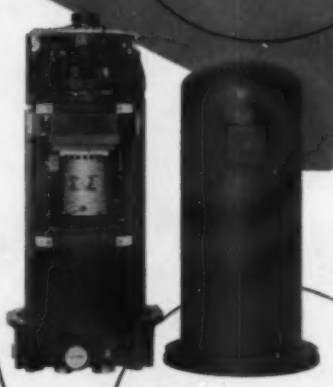

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Another Unmatched Facility to Improve Fuel System Capabilities for Turbine Engine and Missile Application

Fuel handling and control problems for turbojet engines capable of powering sustained Mach 2 flight are enormous. Some are still unsolved despite years of effort. But problems of this type for engines of the future—for aircraft to fly at Mach 3 or 4—are almost beyond belief in their complexity.

The Fuel Systems Laboratory at Pratt & Whitney Aircraft helps to solve such problems and many others in the design, development, qualification, and calibration of fuel controls and related engine parts, by permitting operation of these units at the conditions encountered at high speeds and high altitudes.

This multi-million dollar laboratory, unduplicated anywhere in the aircraft engine industry, was built and is owned by Pratt & Whitney Aircraft. Fuel handling test environments are provided from –65°F to 1000°F, and up to 60,000 feet in simulated altitude. A variety of fuels can be handled through a great range of flow rates, pressures, temperatures, and operating conditions.

Because of Pratt & Whitney Aircraft's foresight in making available this kind of facility, and the many other matchless tools and facilities which engineers at Pratt & Whitney Aircraft may call upon, the uniquely successful J-57 and J-75 turbojet engines have been made available to the world of aviation.

In these facilities, the next generation of aircraft power plants is now being brought along. And such facilities will be even more important in future years in the design and development of the world's best aircraft propulsion systems . . . in whatever form they take.

Pratt & Whitney Aircraft's J-57 engines power the outstanding Boeing KC-135 tanker-transport, shown refueling a McDonnell F-101, also J-57 powered and holder of the world speed record of 1207 mph. In April a KC-135 set a distance record for jet aircraft without refueling, flying 10,228 miles from Tokyo to the Azores. Facilities at Pratt & Whitney Aircraft such as the Fuel Systems Laboratory are behind the success of J-57 and J-75 turbojets in so many types of transports, bombers, and fighters.

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"Helicopters are easy to fly"

Here's what fixed wing pilots say about the transition to a Bell

Chief pilots and airfleet supervisors often ask us: When a company buys a Bell, does it also have to "buy" a helicoper pilot? The answer, of course, is *no.* Transition from fixed wing to helicopters will be one of the simplest, most satisfying jumps you've ever made . . even easier than learning to fly your first light plane.

Read what Rod Fraser, President of Aircopter Transport, wrote us recently: "I'd had 3400 hours of fixed wing. I soloed a Bell in 5 hours. It's my opinion that fixed wing pilots have an 'air wiseness' that's a great aid to transition. So much of the stuff is similar. One point that particularly stuck with me is — you can get plenty of power-off landing practice in a helicopter course; far more than in fixed wing forced landing procedures."

Or take Chief Pilot S. M. Maxwell of Burlington Industries. He writes: "I soloed the Bell in 8 hours, 10 minutes. After the prescribed Bell training we

had our Commercial Helicopter Rating. Since that time we've used our machine in the mountains, on top of buildings, in front yards of plants, under every imaginable landing configuration (at gross limit), and there hasn't been a minute of mental strain."

The folks at Bell would like to tell you a lot more . . about helicopter training generally . . and about the vital place a Bell has in today's airfleet. We'll tell you also about Charter Service, Bell's Lease/Purchase Plan, and about Outright Purchase and upkeep. Just drop us a note, Department 23 F, Fort Worth, Texas. Prompt answer guaranteed!

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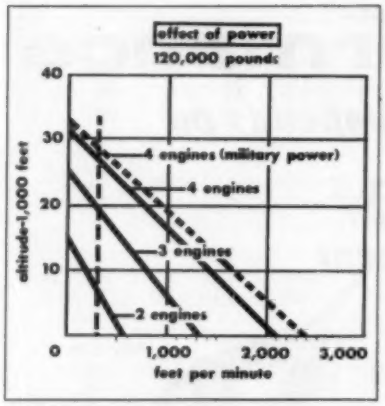

C-130A rate of climb.

matic fuel control panel, with quantity and pressure gages and warning lights, gives crew quick and easy visual indication of status of system. Five fire emergency control handles, one for each engine and one for gas turbine compressor, route 28v. d.c. power to motor-operated engine firewall and gas turbine compressor fuel supply shutoff valves.

Electrical Systems

Three electrical power systems provide 28v. direct current; 115/200v. 380- to 420-cycle 3-phase unregulated alternating current, and 115v. 400-cycle regulated alternating current.

A 24-v., 36 amp./hr. battery, located in fuselage compartment forward of crew entrance door, supplies power to the battery bus and to isolated bus.

Dry weight of C-130A is 61,300 lb. For each flight we had slightly over 4,000 gal. of fuel aboard. In each instance we grossed out about 90,000 lb. Total fuel capacity of airplane, with over-wing fueling, is 5,250 gal. C-130A may be refueled in nine minutes through single-point refueling. Maximum gross weight—124,200 lb.—is limited only by requirements specifying that landing gear be designed for a 2G taxi load at maximum gross takeoff weight.

Fuel is carried in four internal wing tanks. Two outboards hold 1,360 gal. each; two inboards, 1,265 gal. each. With all tanks filled to capacity, weight concentrates at one spanwise location on each wing. This fuel center of gravity is outboard of wing center of pressure. This relieves wing bending and permits additional payload to be carried.

Maximum of 35,178 lb. of fuel can be carried in wing tanks. Limit won't be reached with JP-4; total weight would run 34,125 lb. (5,250 times 6.5). With heavier alternate fuels, such as JP-5, or with cold fuel, limit could be exceeded.

Challenge-type checklist was used with all crew members in flight station and on intercom. "Hot mike" allows pilot to transmit to all crew stations without depressing his microphone button. Copilot read checklist aloud; response was given by pilot, copilot, flight engineer, navigator and ground controller. Engines were started in 3-4-2-1 order; C-130 is self-sufficient.

C-130's auxiliary powerplant supplies compressed air, electric power and emergency hydraulic pressure. Gas turbine compressor supplies air; air turbine motor, driven by portion of compressed air, powers a d.c. generator and a hydraulic pump.

Compressor, located forward in left wheel well, supplies compressed air for ground operation of air turbine motor, engine starting, nacelle preheat and air conditioning system.

Starting procedures on the big turboprop are simple. With air turbine motor running and bleed air valve switch open, engine condition lever is held to "air start" until blade movement stops, then placed in "run." (This positions blade to flat pitch to reduce drag for start.) With fuel boost on and fuel enrichment normal, pilot actuates starter.

Starting cycle is automatic and requires no further action so long as engine accelerates smoothly, turbine inlet temperature is normal, and engine stabilizes on speed within one minute.

During normal start following sequence of events will be noted: light in starter button will glow; rpm. indication will show. At about 10%, oil pressure will show reading. At 16%, secondary pump pressure light will glow, fuel enrichment flow will be indicated, lightoff will follow. Starter button will pop out, and at about 65% rpm. secondary pump pressure light will go out.

Engine will accelerate to ground idle rpm. in about one minute. Same procedure is followed for other engines.

Battery engine start may be made under conditions of low air density, without external power, if gas turbine compressor is unable to supply sufficient air to power both the engine starter and the air turbine motor.

Hercules rides smoothly while taxiing and for its size can pivot tightly. Nose wheel, hydraulically actuated, is linked to manually operated steering wheel, at left of pilot's control column. Directional control, limited by mechanical stops, runs 60 deg. right and left of center. Turning radius is 83.8 ft. for wing tips; 35.8 ft. for nose gear.

While taxiing we checked brakes which are disk-type, hydraulically operated, and installed on each of four main-gear wheels. Brakes operate from utility hydraulic system, with alternate supply available through emergency

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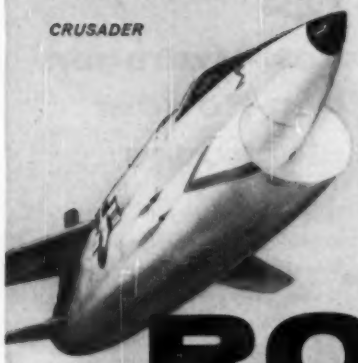

58

Vital Electronic Units in Chance Vought's F8U Crusader Aircraft and Regulus Missiles are Protected by

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Met-L-Flex mounting systems isolating against shock and vibration

17 FOR F8U AIRCRAFT...

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- APQ-51 RF Head
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- APQ-51 Power Supply
- APQ-51 Modulator
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41 FOR REGULUS I, II MISSILES...

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- Destructor Control
- Function Relay Calibrators (2)
- Relay Switch
- Sensitive Relay
- Flight Position Terminator
- Inertial Guidance System
- Pressure Switch
- Video De-Coder
- Beacon Transceiver

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West Coast Engineering Office: Santa Monica, Calif.

system. We also checked brake anti-skid, which prevents skidding of brake wheel when too much pressure is applied. Prop reversing was checked by placing symmetrical pairs of throttles in full reverse.

Thrust of engines mandates running up two engines at a time to takeoff power. Electronic fuel control was checked against turbine inlet temperature (TIT). Throttle (power lever) selects TIT, then fuel system and prop combine to give rpm. and fuel for selected TIT. Prop operation (via governor switches) was checked against 850C TIT.

With throttles advanced to takeoff power, rpm. should be 99 to 101%; TIT at 977C maximum and 957C minimum. Fuel flow, pressures and temperatures were checked for normal operating limits.

Before takeoff we lowered flaps 50%. Four flaps are Fowler high-lift type, with outboard and inboard flap in each wing. When 100% extended they form angle of about 35 deg. with wing. Control lever calibrates range from "up" to "down" in increments of 10%.

Takeoff from the 10,000 ft. runway was made to the west. Wind was from 340 deg. at 8 kt. Outside air temperature was 14C. Sea level pressure was 29.96 in.

Off the Ground

Brakes were held until full throttles were applied. On release we accelerated fast and were off the ground within 1,700 ft. at 90-95 kt. Initial climb speed was 110 kt., which was increased to 160 kt. Visibility was excellent. Ship trimmed easily and only finger-tip pressure was required for controls.

Rate of climb, 3,500 fpm., dropped off only 100 fpm. at 6,000 ft. Noise level also abated once we were in the air. Sitting on the ground, it's no secret once the powerful turboprops are started.

At 10,000 ft., with 4C OAT and 1,100 shp., indicated airspeed was 205 kt. At this speed we felt again acceleration thrust of C-130A. Throttles were advanced and plane jumped forward to 270 kt. indicated; then reduced back to indicated 205 kt. This jerked us against our seats.

Our cabin pressure altitude was 1,000 ft. We depressurized to flight altitude of 10,000 ft. at 250 fpm. Range of depressurization extends from 100 fpm. to 2,000 fpm. Aircraft we flew was limited to 5 psi. cabin differential pressure. Aircraft now rolling out have 7.5 psi. allowable. During troop carrier operations cabin pressure altitude is held to 10,000 ft. maximum. It can be adjusted to any altitude before takeoff.

We climbed to 25,000 ft. holding

HONEST JOHN artillery rocket depends on G-E electric heating blanket (inset) to bring missile to uniform operating temperature before launching.

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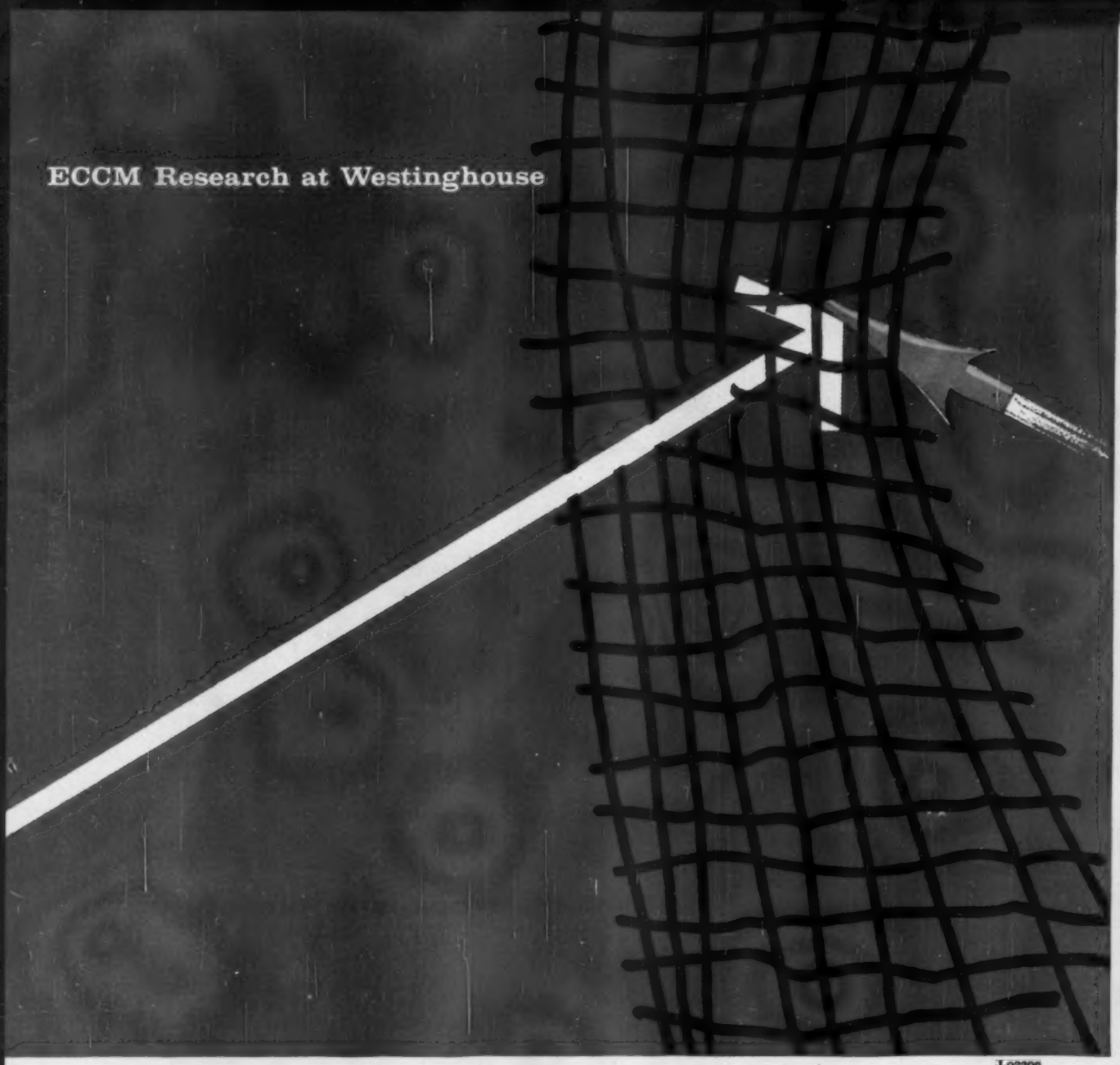

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160 kt. IAS. Passing through 20,000 and 23,000 ft. our rate of climb was 1,800 fpm. Free air temperature at 23,000 was–24C; TAS in climb was 225 kt. Leveling off at 25,000 ft. cabin pressure altitude held to 9,000 ft. At altitude, under normal rated power, we indicated 220 kt. and trued out at 326 kt. Stability and control were excellent.

Before climb to 35,000 ft. we put on P4 helmets and oxygen masks. Oxygen system is diluter-demand, gaseous-type.

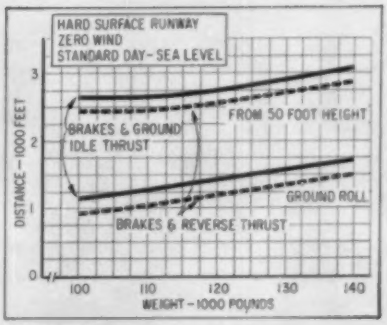
Four fixed units allow one hour's supply to each crew member. Additional cylinders may be added. Two portable units are available for walk-around. Regulators are D-2A or D-2 pressure demand.

At 35,000 ft. our cabin pressure altitude was 14,000 ft. Outside air temperature was–48C; shp. was 1,320 per engine and TIT was 927C. Fuel flow was 700 lb./hr./engine. Our indicated airspeed was 160 kt. for a true reading of 292 kt.

Descent from 35,000 was made at 165 kt. IAS. Lowering the gear, and with full flaps, we slowed to 140 kt. indicated. Our angle of descent was about 14 deg. We went down at rate of 3,500 fpm.

Stall Characteristics

Hercules was stalled at 10,000 ft. with gear down and flaps at 50%. With power at normal, airplane practically stands on its tail. With power retarded, nose was raised and buffet-warning came at about 82 kt. IAS. C-130A stalled at about 73 kt. Lateral stability was excellent and with normal recovery technique (simultaneous power and nose-dropping) loss of altitude was negligible. Rudder is less effective than ailerons for leveling wings in stall or near-stall.



LANDING distances, C-130A.

Good flying characteristics were evident during all flight regimes. Boost control makes it easy for pilot to exceed specified limits. Hercules is limited to 60 deg. angle of bank. Limit speeds are 183 kt. with 50% flaps; 145 kt. with 100% flaps; 168 kt. with gear extended.

C-130 air speed indicator is yellow-lined at 145 kt.–maximum allowable with full flaps. Red-banded pointer on indicator constantly shows structural speed limit, or air speed corresponding to limiting Mach number, whichever is lower, for airplane in clean configuration and for momentary pressure altitude. White pointer shows indicated air speed.

Airplane's hydraulic pressure is distributed through three systems: booster, utility and emergency. Normal operating pressure is 3,000 psi.

Normal operation of aileron and elevator booster cylinders makes use of pressure from both sources. Emergency system can be actuated for emergency landing and normal or emergency ramp operation. Six accumulators, precharged with air to 1,500 psi., are connected to power supply systems to store reserve pressure for peak load requirements and to dampen pump ripple.

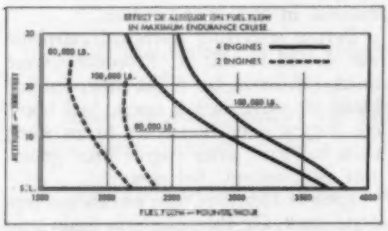
Utility hydraulic system provides pressure for one of dual elevator and aileron tandem booster cylinders, main and nose landing gears, locks and doors, wing flaps, steering and brakes. It also acts concurrently with booster system as source of pressure for rudder control circuit.

Airplane's lateral trim is obtained through tab on left aileron. Manually adjustable tab is located on right aileron; compensates for any imbalance about longitudinal axis. Each elevator control surface has one trim tab. Minor directional control for yaw conditions is compensated by rudder trim.

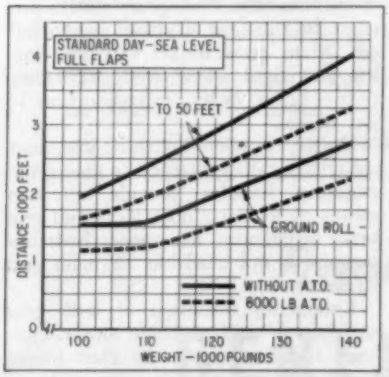
In case of complete flight control system failure, airplane would be flown at reduced airspeed with, of course, greatly increased pilot effort.

Anti-Icing

Hercules controls icing via hot air for leading edges, engine inlet air ducts, radome and nacelle preheating. Electrical heating is provided for props, prop spinners, pitot tubes. Nesa heating units are supplied for three main windshield panels, two on each side of main windshield, and two lower panels



C130-A fuel consumption at maximum cruise (above). Below, takeoff distances.



C-130 A-B Comparison Data

CHARACTERISTICS	UNIT	C-130A	C-130B
Engines (four Allison turboprops)		T56-A-1A	T56-A-7
Takeoff power	eshp.	3,750	4,050
Propellers — No. blades/diameter	no./ft.	3/15	4/13.5
— gear ratios		12.50:1	13.54:1
Total fuel capacity	U. S. gal.	5,080	6,900
Operating weight	lb.	62,712	69,300
Maximum takeoff weight	lb.	124,200	135,000
Maximum payload (load factor 2.5)	lb.	35,000	35,000
Range with maximum payload	naut. mi.	1,800	2,125
Range with 25,000 payload	naut. mi.	2,500	3,100
Landing dist. from 50 ft. (max. ldg. wt. brakes only)	ft.	2,780	2,780
Takeoff dist. to 50 ft. (max. gr. wt.)	ft.	3,150	4,100
Cruise ceiling (max. gr. wt.)	ft.	26,500	24,200
Rate of climb, 4 eng., military power, — sea level, max. gr. wt.	ft./min.	2,300	2,120

DIMENSIONS (BOTH AIRCRAFT)	
Wing span	132.6 ft.
Length	97.7 ft.
Height	38.0 ft.
Tread	14.3 ft.
Prop Ground Clearance (Aeroproducts three-blade, 15 ft. dia.)	5.0 ft.

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Stub E connectors are *fully approved* MIL-C-5015C MS connectors, meeting or surpassing the environmental resistance requirements of that Specification. Stub E connectors are also the *stubbiest* MS "E" designs available — AMPHENOL took advantage of every space-saving trick in the engineer's book while at the same time meeting all dimensional requirements of MIL-C-5015C.

Stub E connectors have a fully unitized rear sealing grommet assembly in which the grommet, compression nut and ring are a single unit, making assembly and disassembly quick and easy. Solder pockets of the silver-plated contacts are pre-filled for easier, less expensive soldering.

Shell styles 3100, 3101, 3102 and 3106, sizes 8S through 36 and 51 insert arrangements are available.

AMPHENOL

AMPHENOL ELECTRONICS CORPORATION
Chicago 50, Illinois

on pilot's side. These contain Nesa layer and vinyl sheet between inner and outer layers of glass.

Nesa units are automatically controlled by thermistors embedded in the vinyl sheets. However, when temperature drops below —40C, thermistors no longer allow power to be supplied heating units. Pressing Nesa reset switch will close electrical circuit which bypasses thermistor units and supplies 115 v. unregulated-a.c. power to heating units.

For wings and empennage, high pressure hot air varying from 260C to 371C is supplied to main manifold from last compression stage of each engine. From there hot air is conducted to anti-icing ducts on leading edges. Air flows from ducts through small nozzles and mixes with ambient air in leading edges. Process reduces air temperature to about 177C.

Leading edge areas are divided into six nearly equal sections. Equal heated areas in empennage consist of horizontal stabilizer and one-half of vertical fin.

Feathering Procedure

Pilots that have flown Hercules consider two engine operation normal. I am inclined to agree with them.

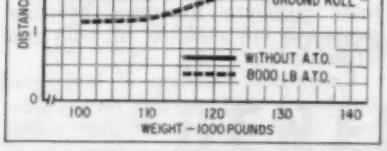
We feathered both outboards at 21,000 ft. With both inboards at normal rated power, Hercules indicated 200 kt. After feathering first engine, less than 5% of rudder trim was necessary to retain stability. Airplane was quite easy to handle and maneuver; no great amount of force was necessary at any time. USAF has flown airplane across continent on two engines; airplane also has performed routine overwater search mission in this configuration.

Before restarting outboards airplane was slowed to 150 kt. Procedures were quick: throttle to flight idle; engine bleed air valve switch open; fuel boost on; engine condition lever to air start, then to "run" after engine fires; generator switches on. Set power.

Each of Hercules' four wheels has separate strut. Gearbox contains main gear spring-loaded brake lock assembly which holds gears until released hydraulically or mechanically. Emergency system provides fluid in case of utility system failure. Main gears retract vertically into left and right wheel well. Retraction time is 12 sec. or less; extension time 15 sec. or less.

During complete hydraulic loss, manual release cables attached to emergency engaging handles provide alternate means of releasing door locks and gear brake mechanism. Emergency hydraulic pressure is not available for main gear retraction.

Emergency extension of both gear and flaps is via air turbine motor. Gear lever and flap switch are then placed to emergency down. Flaps cannot be re-



Wing span	132.6 ft.
Length	97.7 ft.
Height	38.6 ft.
Tread	14.3 ft.
Prop Ground Clearance (Aeroproducts three-blade, 15 ft. dia.)	5.0 ft.

A. F. TRUMBULL, Superintendent of Electronics Engineering, United Air Lines, **SAYS:**

"United numbers all tubes, to record their performance. We can prove G-E 5-Star dependability!"

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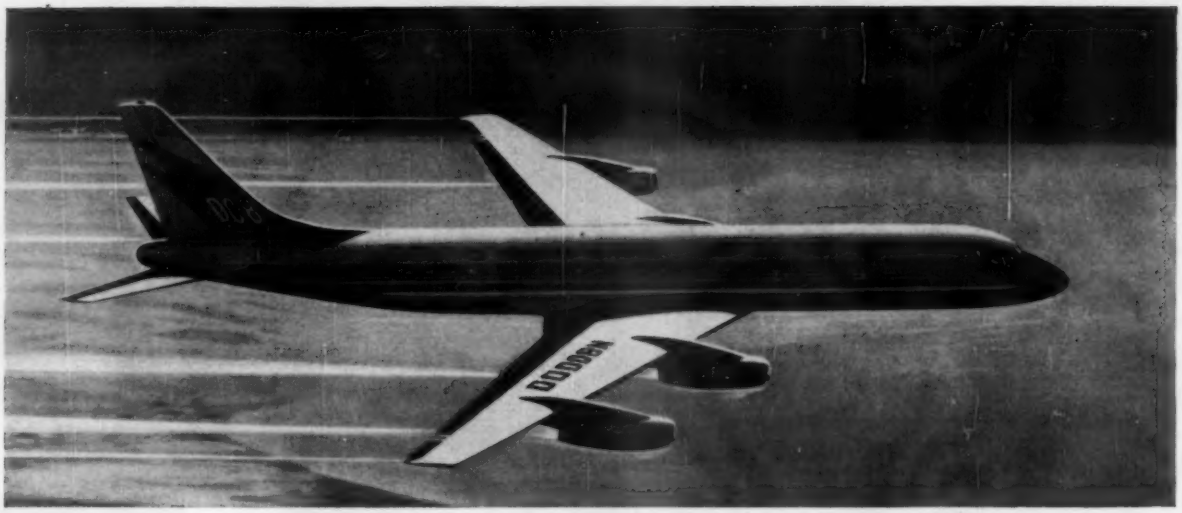

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Nose-gear is swing-type, hydraulically actuated. Fluid is supplied by utility system for extension only. Gear cannot be retracted by emergency means. Manual release cable provides alternate means of lowering. Gear is pumped into down-locked position by forward cargo door hand pump.

We brought airplane into downwind at 1,500 ft., lowering gear at 168 kt. Hercules slowed to about 140 kt. with half flaps. Full flaps were lowered turning on base. Final approach was made at 120 kt. We were over the fence in 95 kt. Control was good. Using normal procedures we came to easy stop within 2,000 ft.

Despite its size, Hercules is a fast airplane. It set new speed mark of 406 mph., average between Dover AFB, Del., and Lajes, Azores--a 2,680-mi. hop. Time was 6 hr. 38 min.

C-130A Capabilities

Other facets of Hercules' versatility:

• **In ski-lift tests** for USAF, at gross weight of 124,000 lb., "Ski-130," using 8,000 lb. of jet assist (JATO), was airborne in 1,450 ft. Without jet assist Hercules got off snow and ice in 2,100 ft.

• **Switch from troop-cargo** carrier to refueling tanker, and back again. In Marine-Navy tests, fighter planes hooked up with drogues extending from Hercules at 15,000 to 25,000 ft. Hose reels and drogues were housed in wing pods.

In production models, 6,000 gal. of fuel can be placed in cargo compartment and pumped through pods.

• **Support capacity** to crack USAF Thunderbird aerobatic team, because of compatibility in support of F-100 Super Sabre. Team has requested another for permanent support.

• **Endurance at altitudes.** C-130A flew 14 hr. 1 min. continuous flight at altitudes ranging from 5,000 to 30,000 ft. Fuel consumed: 4,000 gal.

• **Thin-air takeoffs.** At Quito, Ecuador, altitude 9,000 ft., Hercules was airborne in less than 3,500 ft.

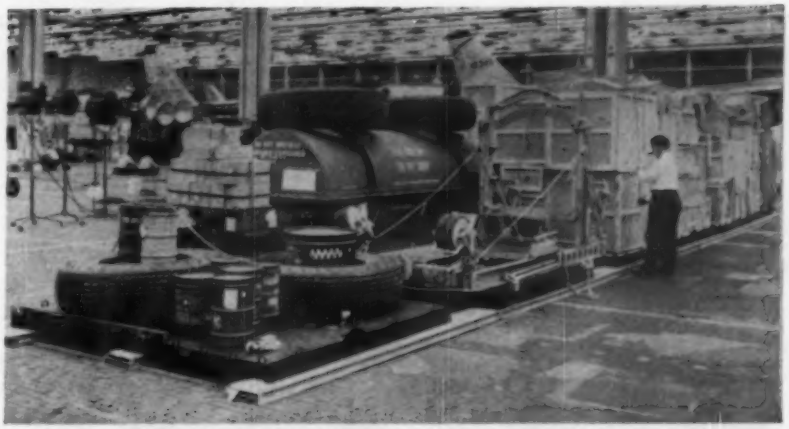
C-130s are now operational with Tactical Air Command at Ardmore AFB, Okla., Sewart AFB, Tenn., 1370th Photo and Charting Service at Palm Beach AFB, Fla., USAFE in Evreux, France, and 483rd Troop Carrier Wing at Ashiya Airbase, Japan.

Indications are that MATS will take over Evreux operations this month. Some 42 C-130s then will operate under MATS control.

C-130 Missile Capacity

Most of all known missiles in use today can be carried in the Hercules. Boosters, ground handling equipment and launching mechanisms may be added in many cases. Capacity table follows:

MISSILE	TOTAL LOAD
Honest John	3
Nike Hercules (with booster)	2
Corporal	2
Bomarc	1
Matador	1
Sergeant	2



C-130 cargo compartment can accept six pallets. Individual pallets can be linked together and moved as a single unit.

Model B Orders

USAF contracts for Hercules total about $600 million, of which $100 million is for 53 C-130Bs, first of which is due out in December of this year. Contract on B model will run to Jan., 1960. Rate of production will be about five airplanes per month. Lockheed is thinking in terms of 100 to 150 B models.

Contracts for C-130A cover 231 aircraft, the last of which will be rolled out in Feb., 1959. Former production rate of seven a month has been cut to five. About 150 C-130As have been delivered to TAC. Royal Australian Air Force is getting 12 from USAF. Air Photographing and Charting has one RC-130 test bed, with 15 aircraft on order. Two C-130Bs will go to Coast Guard.

At the Marietta plant the first prototype YC-130 is being converted to test bed for model B components. Airplane will incorporate fuel dump system, standard engines outboard and new engines and props inboard. Test flights are scheduled for this month.

In midsummer testbed will have four Allison T56-A-7A powerplants installed, according to George A. Hines, Jr., flight test project engineer. New turboprops will be installed 10 in. further forward than those on the A model. Result: Better center of gravity control.

Basic Features

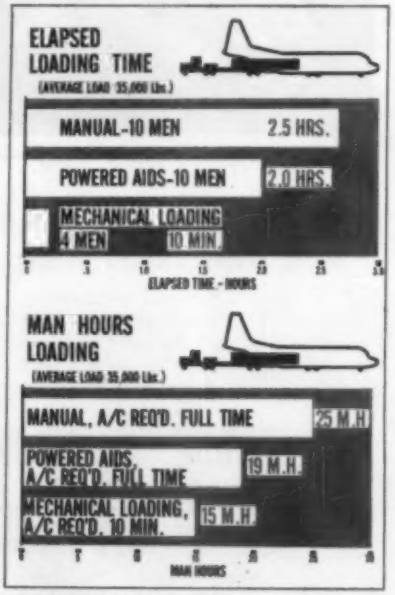
The C-130B has basic features of the A model. In addition, it has:

• **More powerful engines.** Four T56-A-7As generate 4,050 eshp. at takeoff and 3,600 eshp. normal. Dry weight of engine is 1,865 lb. Gear ratio is 13.54 to 1. Maximum cruise speed, under normal conditions, of Hercules would be boosted to 370 mph.

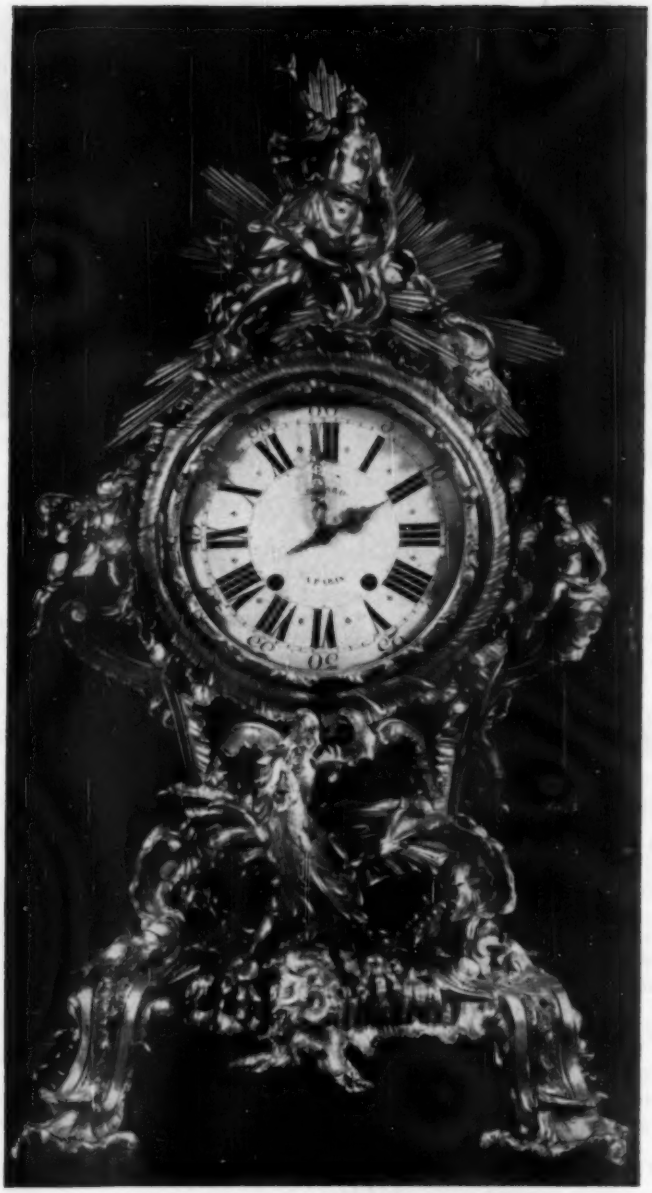
• **Payload and range.** Total fuel carried is 6,900 gal. The total oil capacity is 48 gal. As a combat transport radius is 1,850 mi.; range is 3,570 mi. For logistic support, with maximum cargo of 36,700 lb., range is 2,450 mi. With payload of 22,700 lb. range increases to 4,000 mi.

• **Takeoff-landing weights.** C-130B maximum gross is 135,000 lb., increase of 10,800 lb. over A model.

• **Noise reduction** and soundproofing. B-model engines are fitted with Hamilton Standard Hydromatic 54H60-39 four-bladed propellers. Prop diameter is 13.5 ft.; reduction ratio 13:54 to 1. By comparison, three-bladed Aeroproducts prop used on C-130A runs



HERCULES loading method comparisons.



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15 ft. in diameter; reduction ratio is 12.5 to 1. Reduced tip speed means reduced noise level. Specifically, a nine decibel reduction at external level. Internal reduction should be greater.

Because of its operational flexibility and short and rough-field capabilities, Hercules is readily adaptable to medium and long-range MATS and commercial operation.

Modifications to B model will also include addition of bunks and galley to flight deck. Engineer in C-130B would monitor engine instruments plus systems overhead panel—air conditioning, air turbine motor, anti-ice system, electrical and fuel systems, possibly emergency (fire control) handles.

Electrical system in B would be basically alternating current (A model is a.c. and d.c.). C-130B will also have fuel dump system.

C-130B specifications point to fuel loading of 44,850 lb. via single-point refueling in 12 min. Fuel jettison rate, with all tanks being evacuated simultaneously, is about 2,800 lb. per min.

Commercial Hercules

Commercial version of the Hercules will be the 282A—derivative of the C-130B. Airplane will be available in 1960.

AVIATION WEEK was told that Lockheed is studying the commercial capabilities of the Hercules 282A at various takeoff gross weights up to 150,000 lb. Study potentials, which stress adaptability for over-water operation, include:

- **Maximum payload** of 47,400 lb., with 35,400 lb. of fuel of which 7,000 lb. are reserve. Range would be 2,130 stat. mi. (1,859 nautical).
- **Payload of 36,500 lb.** with maximum fuel. Range would increase to 3,100 stat. mi. (2,700 naut. mi.).
- **Average cruise speed** (TAS) of 325 mph. at 80% cruise power.

Powerplant would be four Allison 501-D22 turboprops. Propellers for commercial version would be "customer's choice." Maximum landing weight, to 121,600 lb. Zero fuel weight to 114,600 lb. Crew would number three.

Cost of the commercial 282A would approximate $2.3 million with same weights as C-130B. Any weight modifications probably would effect price.

Lockheed is presently conducting a study in relation to volume and density of cargo carried by Seaboard & Western Airlines.

Evaluation embraces daily measuring of package widths of all cargo carried by Seaboard, plus sampling of year's supply of air bills giving package weights, etc.

Hercules' cargo compartment runs 41 ft. long, 10 ft. wide and 9 ft. high. Total compartment volume is 4,300 cu. ft., including ramp. Allowing 100 in. for loading height and 18 in. of aisle space on both sides of cargo, usable volume is 3,680 cu. ft.

Large forward and aft cargo doors speed up simultaneous on and off loading.

Positional tail ramp allows loading from varied truckbed heights or directly from ground.

Mechanical Loading

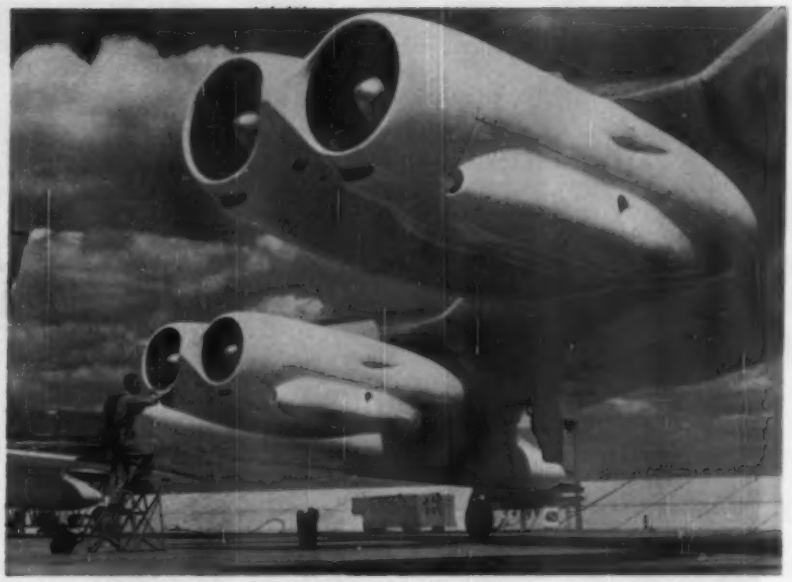
Utilizing Lockheed-developed system, loads up to 35,000 lb. are loaded in 8 min. System incorporates train of preloaded specialized pallets which are moved into cargo compartment.

Mechanical loading can increase utilization potential of Hercules about 2.4 hr. for each loading conducted. Lockheed states that since unloading times are approximately 50% of loading times, use of mechanical system would increase C-130 utilization potential by about 3.5 hr. for each complete loading cycle.

This represents 90% reduction in aircraft "ground time."

Lockheed estimates that en route stop in North Atlantic operations would entail but 30 min. With straight-in loading, Hercules could make 60 min. turn-around.

Computed operating costs of commercial Hercules, based on Air Transport Assn. method estimates, include: aircraft utilization of 3,000 hr. per year; depreciation period equals seven years; engine maintenance allowance equals $66 per aircraft hour; fuel costs (kerosene) equal 14.5 cents per U.S. gal.



External Changes Made on B-52G

Major external change in turbojet engine for Boeing B-52G missile platform bomber is addition of elongated hump to hold alternators, constant speed drives and coolers. Engine is Pratt & Whitney J57-P-43W, being installed at Boeing's Wichita, Kan., production line.

Bristol, Hawker Siddeley Form Propulsion Company

New British aviation company has been formed by the engine companies of Bristol Aeroplane Co. and Hawker Siddeley Group to handle new propulsion projects on a cooperative basis. The new company, Bristol-Siddeley Engines, Ltd., is designed to achieve most efficiency from the combined resources of the two major manufacturers.

Bristol and Hawker Siddeley will share ownership of new company on a 50-50 basis. Sir Arnold Hall is chairman of new company and its vice chairman is Air Commodore F. R. Banks.

Commodore Banks told AVIATION WEEK that the old companies will continue individually to handle their current production lines.

Canadair Ltd. and Bristol Alter CL-44 Sales Pact

Canadair Ltd.'s dropping of Bristol Orion engine for CL-44 transport in favor of Rolls-Royce Tyne 11 (AW Mar. 10, p. 27) has brought about revision of sales and manufacturing agreements with Bristol.

Canadair now retains right to manufacture the aircraft in Canada and to sell it with any powerplant, and for any purpose, anywhere in the world except the United Kingdom, where Canadair will be entitled to sell the airplane for maritime reconnaissance purposes. Canadair says the 1959 rollout will not be affected by engine change.

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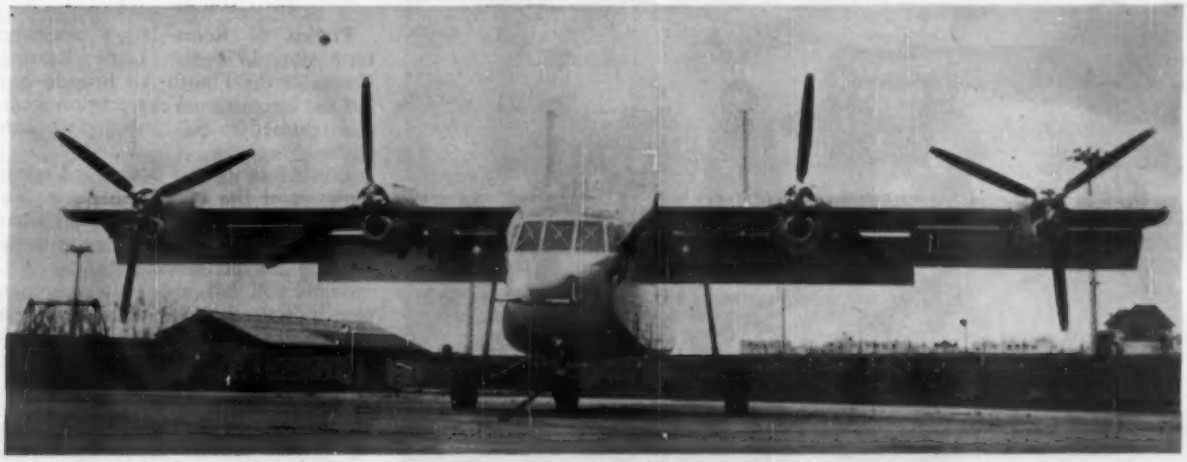
French Reveal SIPA 1100, Breguet Turboprop STOL

French have revealed two new aircraft: the SIPA 1100, above, and the Breguet 940, below. SIPA 1100 is for use in colonial-type actions. Experimental Breguet 940 STOL cargo-passenger transport, due to fly this month, is forerunner of 15-18 ton 941 with 9 ton payload, 280 mph. cruise speed, four General Electric T58 gas turbines of 1,050 shp. The 940 weighs about 7 tons, has 58.8 ft. wingspan, four Turbomeca Turmo II turboprops of 400 eshp. each.



Double flaps run along entire trailing edge of Breguet 940, extend almost 90 deg. Vectored slipstream, combined with traction power of four propellers, tilts aircraft forward. Takeoff length is said to be 360 ft., landing roll less than 328 ft. Fuselage is 49.5 ft. long. Cruise speed at optimum altitude is given as 175 mph. Pilot and engineer constitute crew. Wing skin, floors are bonded honeycomb.

FIVE-PLANE takeoff in a single Vee formation was routine when the Italian aerobatic team flew with four plus one reserve.

1957 TEAM (l. to r.): Paganelli, Melotti, Sguerri, Liverani, Turra. Favretto not shown.

ITALIAN's North American Sabres have cream fuselages, metallized blue surfaces, red noses.

Italian Team

By David A. Anderton

Pratica di Roma—Italy's aerobatic team for 1957—the Little Rearing Horses of the Fourth Air Brigade—has left the international competition scene and returned to full-time flight operations.

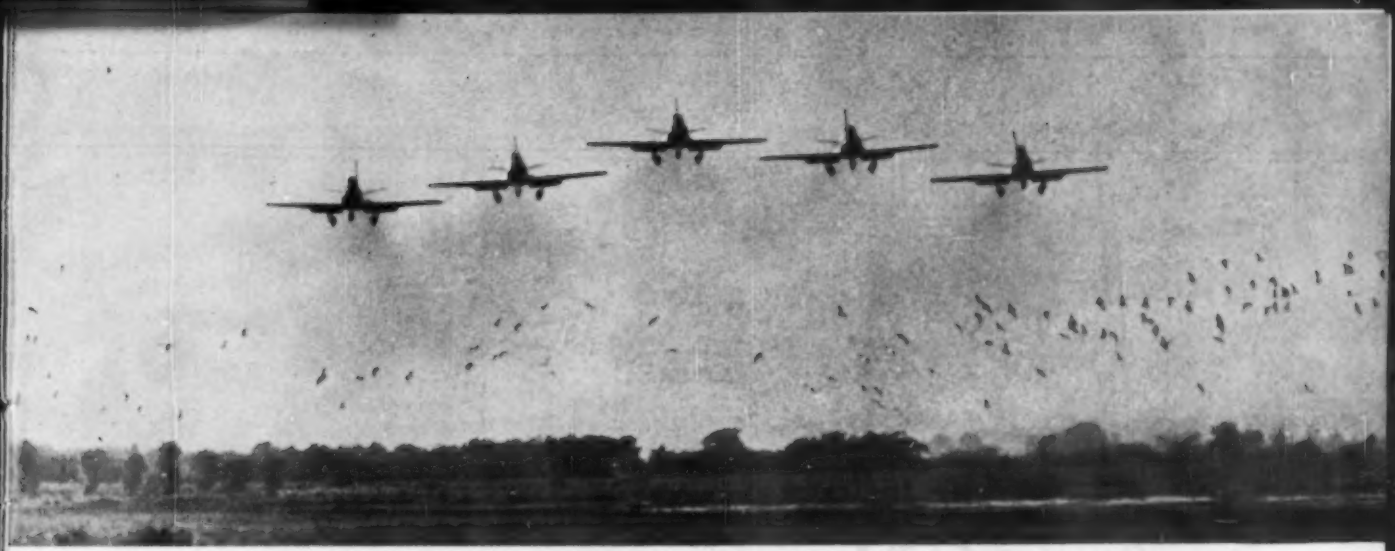
But before its year as assigned representative of the Italian Air Force was over, it had made indelible impressions in the minds of every aviation enthusiast who saw performances.

Pilots still talk about the four-man formation landing the team made on the first flying day of the 22nd Salon International d'Aéronautique at Le Bourget, probably the first such landing touchdown by any acrobatic group. They still remember the belly-straining 7G pullout from a 3,000-ft. high bomb-burst start that concluded the patrol's routine on the second display day at Le Bourget. In a year that featured outstanding performances by aerobatic patrols from many countries, the flair of the Italian team's act stands out strongly in retrospect.

These routines were re-created for AVIATION WEEK with gestures by Capt. Aldo Melotti, 35-year old team leader, in the operations building of the Quarta Aerobrigata (4th Wing) stationed at this seaside base about one hour by car from Rome.

Until one has seen the voluble and enthusiastic Melotti describing a complex maneuver involving a formation change and two direction changes, one has never seen hangar flying. For that one, he ended flat on his back on a table, arms outstretched above his head, having just run out of runway.

Melotti's wingmen are Lt. Claudio Paganelli, 30, who normally flies right wing, and Lt. Ferdinando Sguerri, 28,



FIVE-MAN landing by Italian team has Vee lined up on runway with little vertical separation and lateral overlap of wingtips.

Pioneers in Formation Landings

off the left wingtip. Slot man, or Fanolino (tail-light) in Italian, is 23-yr. old Sgt. Eddo Turra.

Original reserve pilots were Lt. Andrea Favretto, 31, and Sgt. Giovanni Liverani, 27. In the five-man formations, they alternate as fifth man and reserve. Normally each man flies his assigned spot, but all are checked out in all positions.

Italian Air Force encourages the aerobatic teams for the same reasons as other military services: recruiting propaganda, encouragement of competition flying, and to improve individual standards of flying by that competition.

The Fourth Fighter Wing was the first postwar Italian team to enter the international arena of formation flying. It started in 1955 with displays in Italy only, flying the de Havilland 100 Vampires that were the major equipment of the Italian Air Force then. By September, 1956, it had been re-equipped with Sabres, and after a few months' training the team was named to represent Italy for 1957.

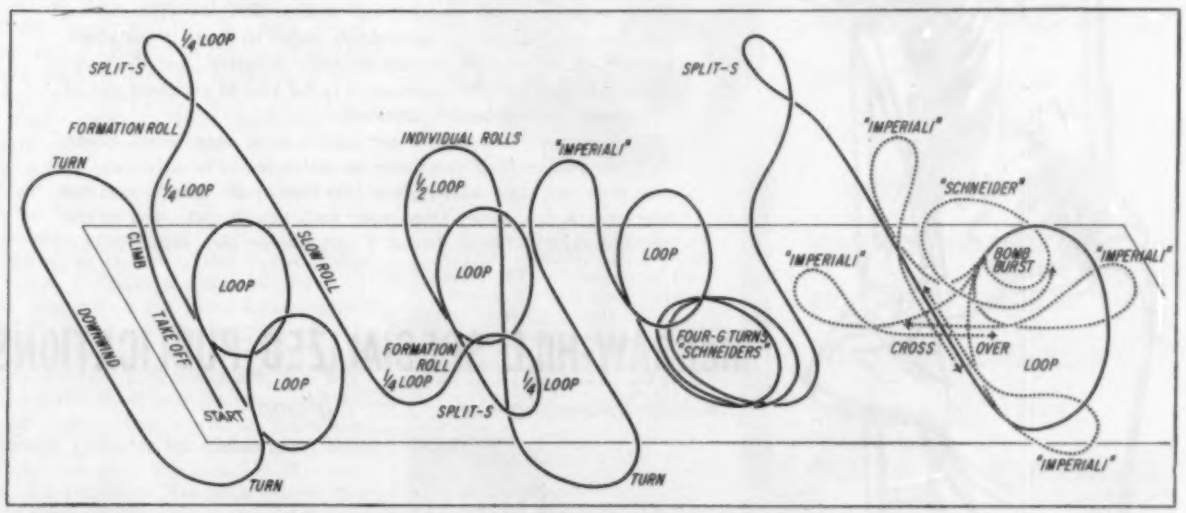
Melotti, who was commanding the 91st Fighter Squadron of the 4th Wing, was named team leader and was given the job of picking the rest of his men. After flying tight formations and acrobatics with everybody in the squadron, Melotti made the difficult choice of five pilots and the team was born.

Acrobatic routines are just part of the job the six pilots have to tackle. Like other outfits, they contribute to the squadron's operations by standing patrols, alerts, and the usual routine flying. On top of this, they do the acrobatic routines.

During winter, this is the arrangement; but last summer, when it seemed that there was an air show every week somewhere in Europe, the team went off operations for a while to fly displays at every opportunity. Toward the end of the year, the schedule tightened even more, and the team flew nine shows in 16 days, which was something of a record.

The planes they fly are North American Sabres Mk. IV (F-86E-15) built under license by Canadair and powered by General Electric J47-GE-13 turbojets. Operational aircraft in every respect, the Sabres sport one of the gaudiest paint jobs of any acrobatic team's equipment.

It starts with a basic cream-colored fuselage, upper wing surface and upper stabilizer surface. A metallized blue



TYPICAL Italian program. Imperiali is an Immelmann. Term "Schneider" is derived from low-level turns of Schneider Trophy races. Dotted lines at right show directions of team breakup and crossovers.

your two best friends... "the man ahead" and "the man behind"

That man just ahead of you hopes you'll take his job away from him. He's plain selfish about it . . . that way you push him up the ladder, too.

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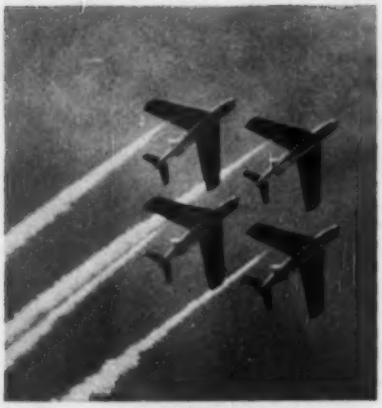

SMOKE streams during tight diamond.

covers the lower surfaces of wings and stabilizer, and the vertical fin, and little stars dot the blue near the tips of the surfaces. A red nose flash covers the forward fuselage and extends back under the belly and along both sides. On the fin, and surrounded by a white cloud, is the figure of a rearing horse in black—the "Cavallino Rampante" ("Little Rearing Horse")—the insignia of Maj. Francesco Baracca, Italy's top ace in World War I.

The team's show is a 10-to-12-min. demonstration that includes 14 manœuvers and six basic formations. Depending on wind, crowd position, field conditions and runway width, there may be alterations in the act which increase the time or change the flight patterns.

Minimum speed during the manœuvers is about 150 kt. and maximum is about 450, with an average speed held through most of the runs between 400 and 430 kt. Turns and pullouts are made normally at a constant 4G rate.

Ceiling required for the routine is 6,000 ft. The team did one show with cloud cover at 5,500 ft., and found themselves inverted in the cloud on one pass. Melotti does not recommend that kind of acrobatic flying.

Early shows in 1957, including the memorable performance at the Paris salon (AW June 10, 1957, p. 26), were flown with four men. But then the Royal Air Force fielded five men in 111 Squadron's routines, including their landing, so Melotti pulled in one of his reserves to finish the last 20 shows of the year with a five-plane formation.

The most spectacular part of the Italians' flying is done the day before a show when they come into the field where the show will be given. All six men and planes make a formation landing, either in two three-plane Vees if the runway is less than 150 ft. wide, or in a five-plane Vee with one in the slot for a 200-ft. wide runway.

One of the difficulties in describing any acrobatic display is the lack of

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Typical Stalker fabrication. Nozzle assembly of nimonic alloy. (Photo courtesy of Continental Aviation and Engineering Corp.)

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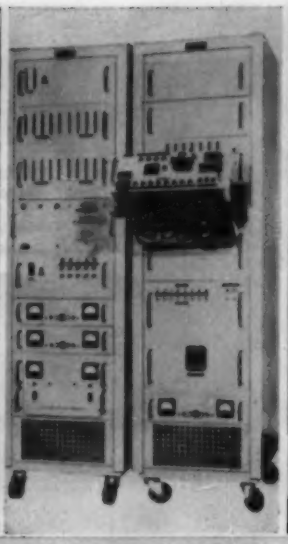

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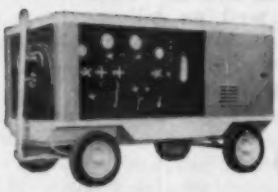

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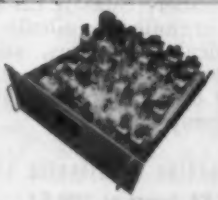
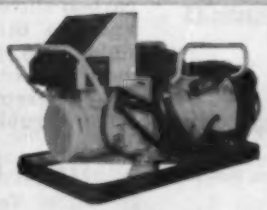
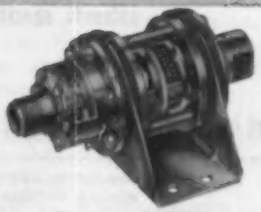


Computer Test Drawer



Motor Generator Set



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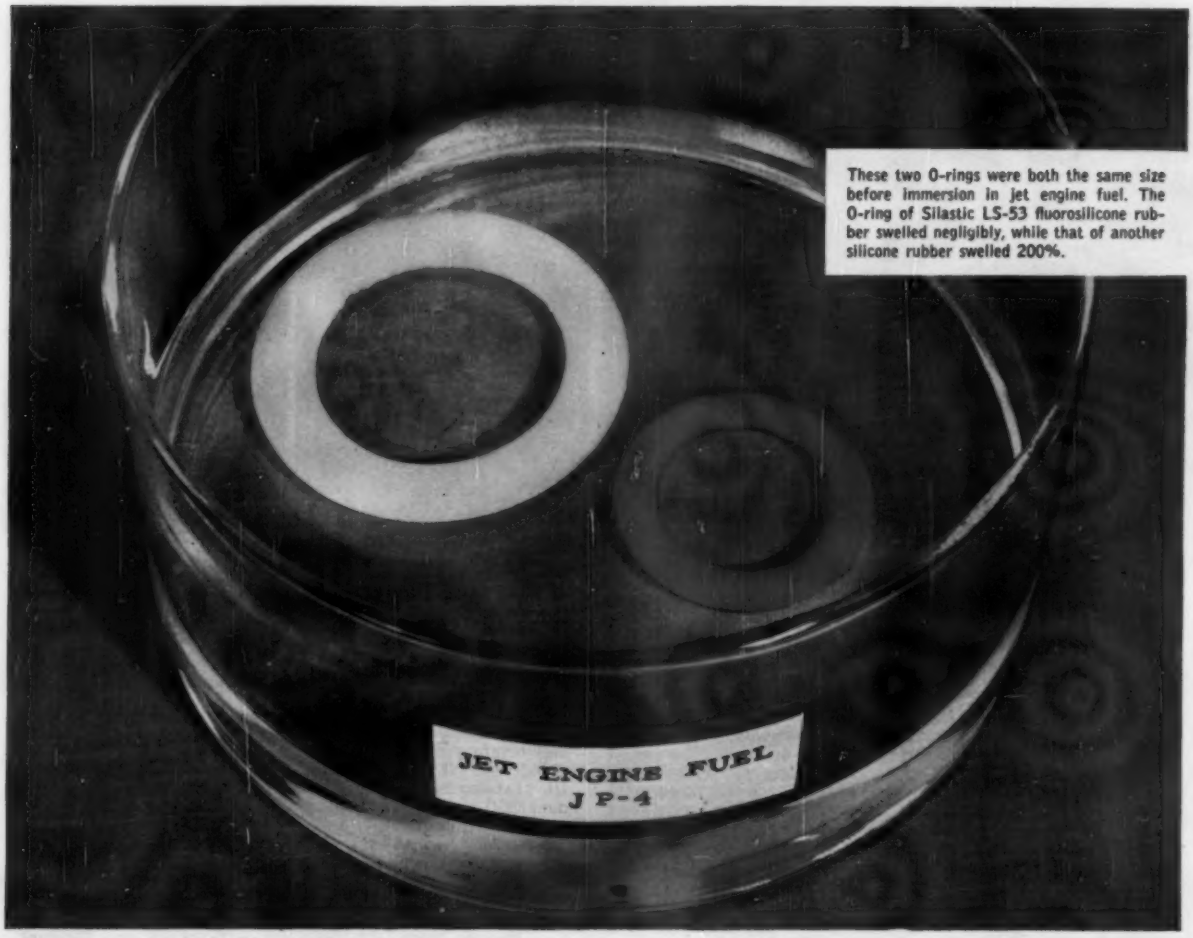

These two O-rings were both the same size before immersion in jet engine fuel. The O-ring of Silastic LS-53 fluorosilicone rubber swelled negligibly, while that of another silicone rubber swelled 200%.

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good and consistent names for the various formations flown by the planes. Nomenclature seems to stop with Vee and Echelon. Basically, Melotti uses six different formations of the five-man team: Vee, Echelon, "H" and three forms of "Arrow."

First two are self-explanatory. The "H" is what the RAF calls the "Card Five" and consists of a square with one airplane at each corner and one in the center.

The three "Arrow" formations all have three airplanes in trail, with two wingmen flying at three different wing positions. For convenience, here, "Arrow One" will be the formation with the wingmen on the first man in line; "Arrow Two" with the formation holding on the No. Two man; "Arrow Three" with both wingmen off the tips of the last man in line.

This is what happens in a typical flight demonstration with a five-man, five-plane formation.

Formation Start

Compressors howling, the six Sabres roll out for takeoff and form on the runway depending on its width. Same rules apply here as for landing: Five-man Vee and one in the slot if the runway's wide, two three-man Vees if it's narrow. With the former, the slot man stays a little to the right of the runway centerline to avoid jet blast.

Melotti gives the command and the formation starts the takeoff run.

If it is the only team exhibiting, it makes a steep climbing turn left out of the field and heads back for the runway. If there are other fly-bys scheduled between takeoff and the demonstration, the team heads out of the field area and awaits tower clearance.

As the team starts back to the field, the reserve man swings out of formation. The five-plane Vee heads in for the run with Melotti pointed straight at the centerline.

Just before reaching the runway, the team pulls up into a loop, goes over the top and starts down the back. During the 4G pullout, Melotti's wingmen slide into trail behind him, and the two remaining wingmen form on the third man in line for an Arrow Three.

This grouping pulls up into a second loop, completes it, and starts into a third loop, still heading down the runway over its centerline. The group completes only the first quarter of the loop and then breaks out of it, immediately going into a formation vertical roll. Out of the roll, it quarter-loops again over on the backs and does a split-S out of the inverted position. This brings the team out headed up the runway, flying straight and level.

Passing in front of the crowd, calls for a maneuver and the team makes an element slow roll. At the end of the runway, the planes pull up again into a quarter-loop, vertical climb and roll followed by the split-S, a duplicate of the maneuver previously performed at the other end of the runway. But during the pullout from the split-S and while starting the run down the field again, the team slides from the Arrow Three into a Right Echelon.

LEADER is front-left in H formation.

Over the runway, the team pulls up into a loop and follows it with the start of a second loop. But on top of that loop, each man rolls individually on his own axis through 180 deg. so that the Right Echelon becomes a Left Echelon. The Echelon swings out away from the runway and starts a turn to bring the team heading back down the field again. During the turn, the formation changes from Left Echelon to the Arrow Two layout.

Next on the list is the Imperiali, Italian for Immelmann, which takes the team up and over in that classic evasive maneuver developed by the German ace during the early days of the first World War. Down they come toward the runway again, and shift position into the H formation during the pullout from the Imperiali.

The Sabre square pulls up into another loop; on the pullout, the team changes formation again into the five-man Vee and swings into a tight left turn off the end of the runway. Pilots hold a constant 4Gs during one complete circuit of the field, with perhaps as much as two wing spans of air between the low man and the ground. The team calls this tight sea-level circuit a "Schneider" after the low-level turns of the Schneider Trophy races.

Starting a second circuit of the field, and halfway through the 4G turn—opposite the crowd and on the other side of the field—the team changes formation into an H again, completes the turn and heads down the runway.

The formation climbs into a split-S turn, but while inverted in the S, it shifts from the H to Arrow One.

Now the team roars up again into the last of its loops and goes over the top in Arrow One formation. Just before the group reaches a vertical nose-down attitude, the fifth man drops out of the formation, leaving a tight diamond of four planes with Melotti in the lead.

Melotti gives the order; smoke pours from the generators under each Sabre's right wing and the formation screams into its bomb-burst. Melotti begins his pullout, Sguerri on his left wingtip half-rolls left, Paganelli on the right half-rolls right, and "Fanolino" Turra does a 180-deg. roll. The fifth man—either Favretto or Liverani—pulls a tight turn at the top of this burst, also streaming smoke, leaving a white halo in the air from which the four plumes trail down and away.

Normally this pullout starts at 4,000 ft. But at the Paris display on the second day, Melotti—who had been "outlanded" by the five Hunters from 111 Squadron—started the bomb-burst at 3,000 ft. He admits the ground got very close—so does this observer, who shuddered—and the team pulled 7Gs to break out.

Centerline Crossover

Out of the bomb-burst, each man pulls into an Imperiali on Melotti's command and heads back for the spectacular crossover at the center of the field. Melotti and "Fanolino" use opposite sides of the runway for positioning their runs; the two wingmen—with the fifth man still doing circles above—use another reference, like the President's Tribune at the Paris display.

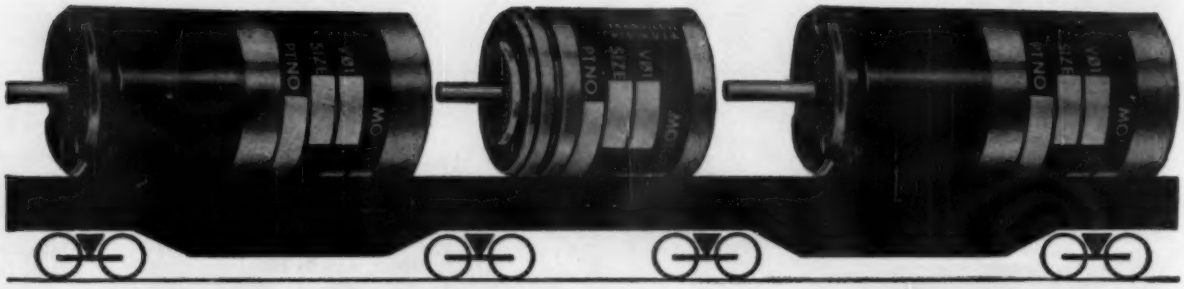
They crossover in the center of the main runway or thereabouts at about 450 kt. indicated.

Clear of the crossover, Melotti loops and Turra does an Imperiali. The two wingmen climb vertically to lose some speed, turn out of the climb to form up on Melotti. The fifth man drops down to join the team again in an Arrow One, and the formation climbs to get altitude for approach.

If the pilots have some time left over, they make a long slow pass down the runway, at five knots above the stall in a tight Arrow One about 100 ft. off the ground. If time has run out, the formation makes a single pass at the field coming up to the end of the runway at 170 kt. with speed brakes open, then climbs left again, dropping landing gear and flaps in the turn. The team completes the 360-deg. turn and is in position to land with everything down and the airspeed killed off.

Runway width determines the landing routine. Wide runways get the five-man Vee. The narrow runways call for an H, with Melotti in the left front airplane.

Down they come, easy in the ap-



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proach and with the formation holding tight on Melotti. Over the fence, over the numbers and markers and then onto the runway, with the screech of tires on dry concrete as the last plane or planes in the formation touches first. The landing progresses from rear to front of the formation, with Melotti last to touchdown.

The superb photograph of the four-man landing at Le Bourget, pictured on the cover of AVIATION WEEK for June 17, 1957, shows "Fanolino's" main wheels just touching and his nose wheel just about one foot off the ground. The two wingmen are about three feet off the surface and Melotti has about six feet under his wheels.

One experienced pilot standing by was repeating profane words to the effect that they really weren't going to land that box, were they? And when the formation was finally and obviously committed to land, he still kept saying they weren't really going to do it.

Since then other formations have landed in more complex variations than a four-man box. The Italians now look on the six-man touchdown as routine.

Masses at Marseille

But lately there has been a tendency to keep adding numbers to aerobatic formations. RAF's 111 Squadron had nine planes start its show at Farnborough last year (AW Sept. 9, 1957, p. 26 and Jan. 13, 1958, p. 54). A few days later at Marseille, the Italian team and the French Mystere group that had also flown at Le Bourget, joined forces to put on a brief 10-plane display with two five-man Vees. Planes did a split-S up off the runway and a formation roll and let it go at that.

Since then the Pakistan Air Force demonstrated with a 16-Sabre formation at Mauripur near Karachi. The planes held a tight diamond and roared up into a loop. Nine of the planes then broke out of formation and the remaining seven completed an ornate acrobatic routine.

But perhaps the last word goes to the Italians again. During the latter part of 1957, a group of USAF and Italian air force officers were watching a 16-plane formation from the IAF doing some of the more basic acrobatic maneuvers. It had formed a big diamond of four smaller diamonds, each composed of four Sabres, and was holding the shape with mathematical nicety through a loop and some other element maneuvers.

One USAF officer said jokingly that surely they weren't going to do a bomb-burst with that formation. "No," said the Italian officer next to him, "they won't do that now." Then he hesitated, his eyes sparkled and he burst out, "But that's a wonderful idea!"

USAF Narrows Plane Production

Washington—Air Force has narrowed the types of aircraft currently in production to 15 and the types of production engines to six, according to a USAF report to the House Appropriations Committee.

Air Force also reported during committee hearings on the Fiscal 1959 budget that:

- **In addition to the 15** production types it has 53 different aircraft types in its inventory that are out of production.
- **During calendar 1957,** USAF phased out 3,139 aircraft of 16 different types. These have either been disposed of or are being disposed of.

USAF told the committee that its overall combat forces, now 99% manned aircraft, would be 65% manned aircraft and 35% missile units by the mid-1960s. The shift to missiles in air defense, now 100% interceptor fighters, will be greater. Air Force estimated that by the mid-1960s 60% of the units would be missile units and only 40% manned interceptor units.

The 15 types now in USAF's production program are: one heavy bomber

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June 16th marks the publication date of AVIATION WEEK's "Research for Space", 1958's most ambitious and dramatic editorial effort. Major areas of editorial attention: missiles, satellites, spacecraft, space probes, Dyna-Soar, avionics, exotic fuels and hypersonic aircraft, are presently engaging the attention of the world and exciting the imagination of scientific and military minds everywhere. The soaring national defense expenditures earmarked for national defense effort in these fields and general aviation procurement, amounting to some $10 billion scheduled to be expended in the second half of 1958, i. e. (January-June 1958) spotlight the timeliness of this issue.

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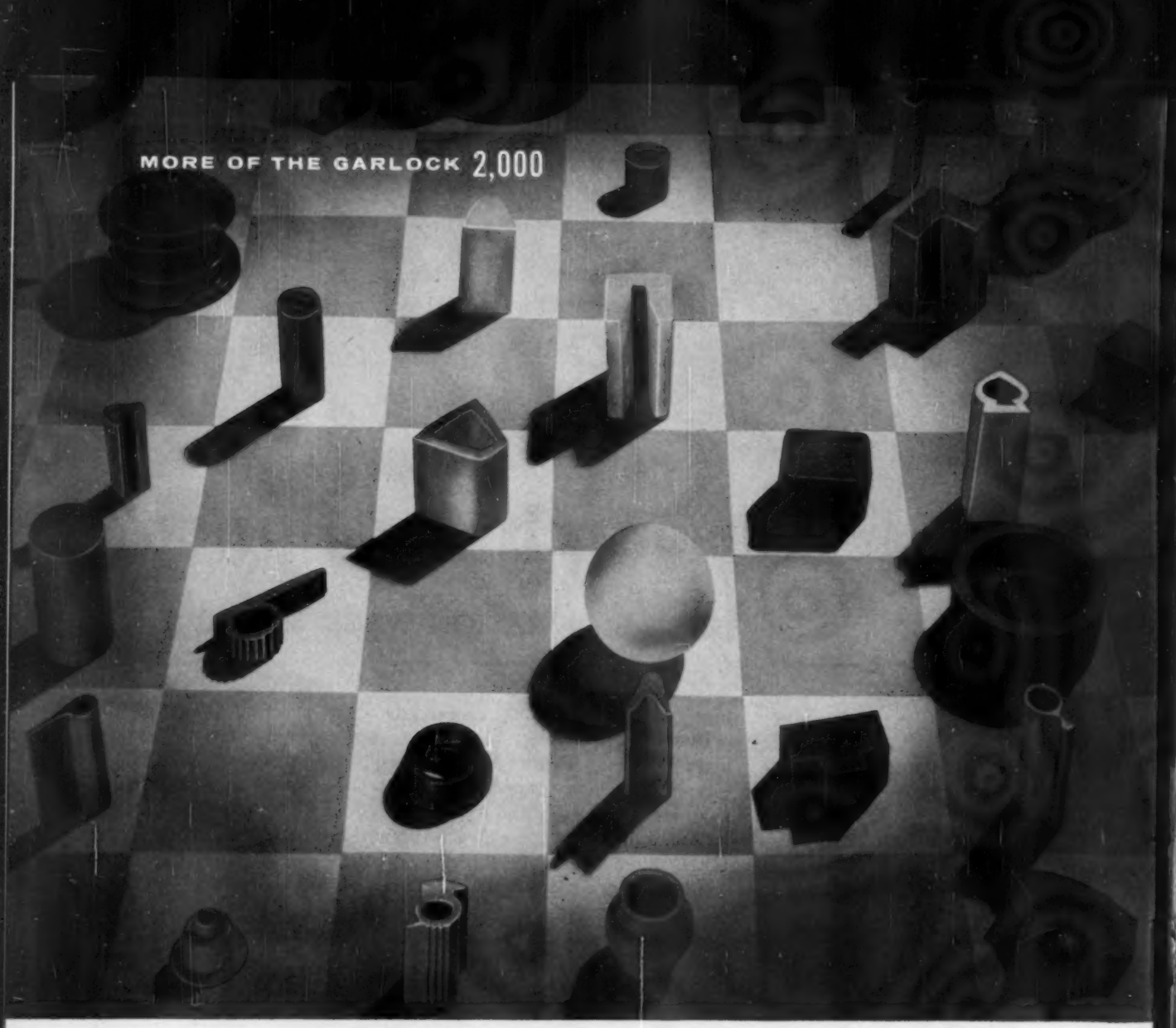

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(B-52); one medium bomber (B-58); three fighter bombers (F-100, F-101C, and F-105); four fighter interceptors (F-102, F-106, F-101B, F-104A); one reconnaissance fighter (RF-101C); two heavy transports and tankers (KC-135 and C-133); one medium transport (C-130); and two trainers (T-33 and T-37).

The aircraft phased out of the USAF inventory last year in the largest volumes were: F-84 (930); T-6 (614); B-29 (489); B-26 (248); B-36 (179); F-80 (116); F-51 (112). Other types phased out included the B-17, B-25, B-45, C-45, T-7, T-28, H-5, and L-5.

Engines in USAF's current production program are: J57, J69, J75, J79, T34 and T56.

Funds in USAF's Fiscal 1959 budget for new aircraft procurement are more than double the allocation for missile procurement—$3.8 billion for aircraft, compared with $1.8 billion for missiles. Of this, $857 million is for ballistic missiles, $936 million for other missiles. These figures, however, do not reflect a supplemental request for aircraft and missile procurement of $518 million submitted a few weeks ago (AW April 7, p. 30).

Testimony by USAF representatives noted:

• **Moon probe.** Cost "to successfully impact a payload on the moon" was estimated at between $16 million and $20 million. Air Force officials said this "would allow five to seven shots with a 70% chance of success for each missile."

• **Dyna-Soar.** Cost of the first Dyna-Soar combination ballistic missile-aircraft will be approximately $150 million.

• **Northrop Snark** intercontinental ballistic missile. Cost of $60.7 million for a Snark squadron would compare with a cost of $150.3 million for a comparable B-52 squadron. The Snark cost would include 15 missiles ($37.5 million), military personnel ($2.9 million), and other support costs ($20.3 million). The B-52 cost would include 15 B-52s ($106.1 million), 10 KC-135 tankers ($26.1 million), military personnel costs ($8 million), and other support costs ($10.1 million). Both Snark and B-52 are in USAF's Fiscal 1959 buying program.

• **Convair Atlas.** After development costs, USAF estimates the Atlas intercontinental ballistic missile will level off to a unit production cost of $1.6 million. Air Force said that no technical problems are anticipated and that the first squadrons will be equipped during calendar 1959.

• **Martin Titan.** The follow-on to the Atlas, USAF reported is "proceeding well" and flight tests are expected to commence this year.

• **Convair B-58 Mach 2 bomber.** The aircraft is progressing through tests to production on schedule and Air Force plans additional procurement during Fiscal 1959 of 47. With the 30 aircraft in previous programs, this will make a total 77.

• **Industrial facilities.** Air Force has $120 million in its Fiscal 1959 program for industrial facilities and equipment. By categories, the productive expansions planned include: ballistic missiles, $18.8 million; other missiles and aircraft, $45.3 million; engines, $15.3 million; special fuels and electronics, $24.2 million.

Other missiles and aircraft on USAF's Fiscal 1959 shopping list include Douglas Thor intermediate range ballistic missile, with a production cost of $735,000; North American Hound Dog electronic countermeasures missile, utilizing existing components (Navaho airframe and guidance system and Navy J52 production engine) which will be launched from the wing-stub of the B-52; Boeing Bomarc area defense missile with a Mach 2.65 to Mach 3 capability, which will require a launching area of 74 acres; GAR guided aerial rocket series for fighter interceptors, including the Sidewinder for use on the F-86D, F-100, F-104, and the F-105; Martin Mace tactical missile follow-on to the Matador; Fairchild Goose missile ECM missile.

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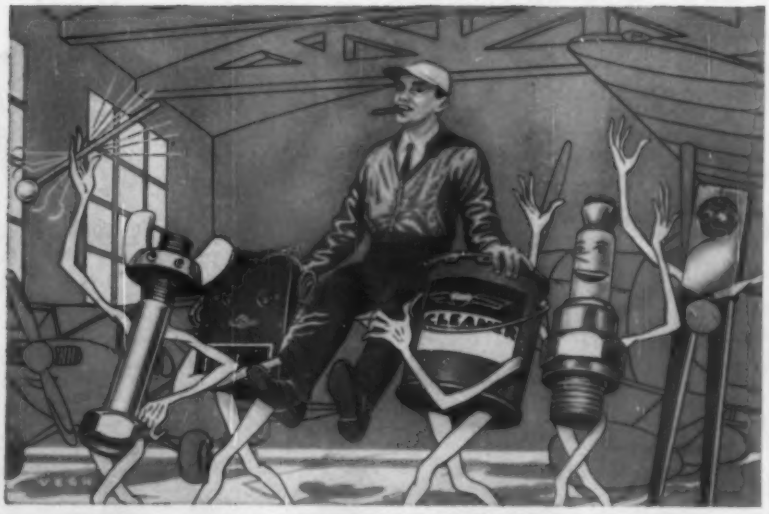

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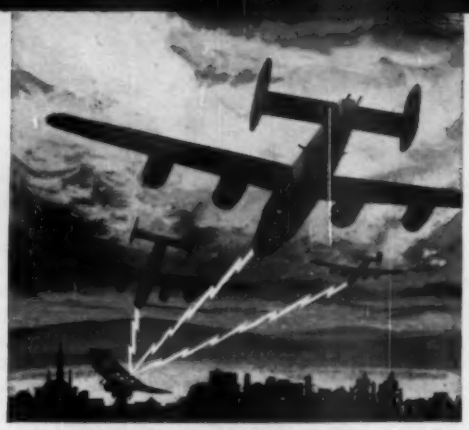
1942 First effective radar countermeasure was "Window," code name for thin strips of metal foil which reflected spurious radar echoes when dropped from Allied bombers, confusing enemy radar operator.



1943 Next came "Carpet," designation for techniques of radiating "noise" or static from bomber-borne transmitters, each tuned to slightly different frequency. Torrent of "noise" produced "rippling grass" pattern on enemy radarscope.

1944 "Tuba" was a tremendously powerful (50,000 watts) jamming transmitter located in England. Its potent signal blinded German night fighters' radar as they pursued RAF formations toward the island.

THE STORY BEHIND THE STORY

COUNTER-MEASURES

U. S. MAKES PROGRESS IN DECEIVING AN ENEMY

TODAY Shown below is only one of the techniques used in Sperry's integrated countermeasures system. U. S. bomber sweeping inland toward target nears anti-aircraft missile installation. Normally, bomber appears as blip on ground radarscope (1). But new Sperry jammer would transmit countersignal on same frequency as enemy radar, completely obscuring echo of signal on ground radarscope (2). This would make it impossible for enemy to tell number, location, or direction of U. S. planes.

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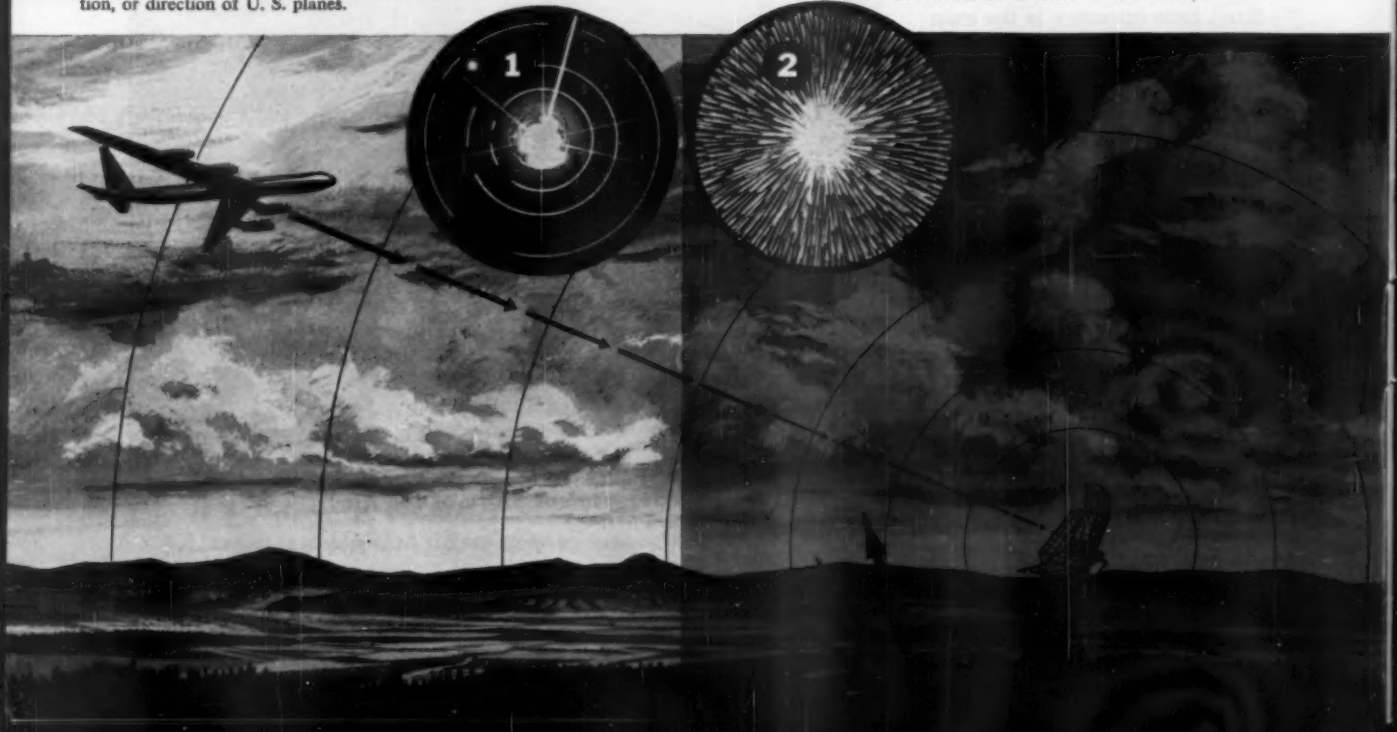


Ducts May Supplement Radio Frequencies

By James A. Fusca

New York—Solution to the overcrowded radio spectrum through communication by use of natural ducts for low frequency radio, sound, light, heat and gamma rays has been proposed by a senior Air Force scientist.

Areas in which experimental work could provide new channels for transmitting messages over long and short distances are described in a paper presented to the Institute of Radio Engineers by Joseph L. Ryerson, chief of the Advanced Development Laboratory, Directorate of Communications, Rome Air Development Center.

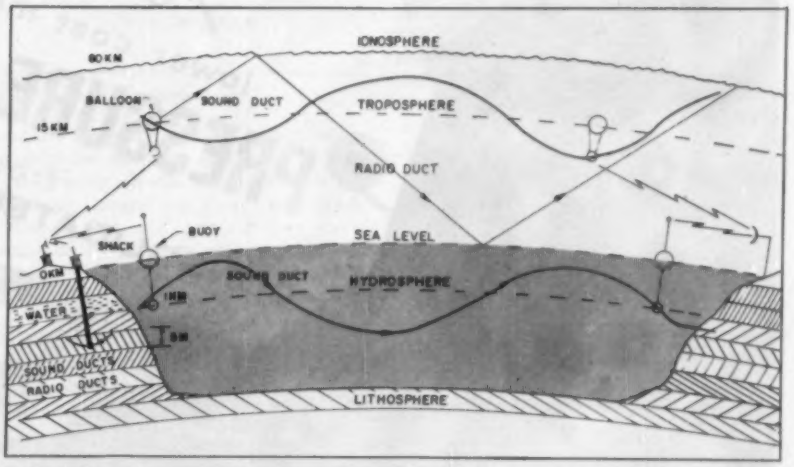
The paper describes means of communication other than by conventional radio frequencies and suggests the potential capabilities of each method. Some of these offer intriguing possibilities for solving the most difficult communications problems the Air Force faces today. The problems:

- **Volume of information.** USAF global communications networks must pass huge volumes of information over channels not only overcrowded but unreliable due to the natural properties of the transmission media used.
- **Delay.** "Subscribers" using Air Force communications nets must communicate without delay.
- **Global circuits.** No single type of communication circuit is satisfactory for the entire world.

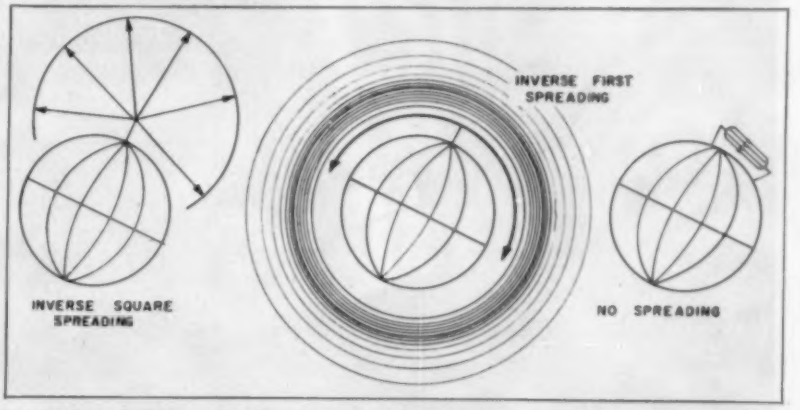
Propagation Considerations

Range of transmitted energy is limited by the nature of the propagation medium and by the equipment used. Reasons why signals are lost during propagation through a medium are:

- **Spreading.** Energy is radiated from a source so that it spreads spherically (inverse square law) or circularly (inverse first law) as contrasted with the ideal case where all energy passes between two points without spreading.
- **Absorption.** One property of a propagation medium is that it attenuates the signal a given amount per unit of range.
- **Noise.** Received signals can be obscured by the presence of undesired signals in the medium resulting from both natural and man-made phenomena. In the case of the radio spectrum, natural noise is caused by lightning and the sun; for the sound spectrum by thunder, wind, rain. In general, the noise level of a medium rises as the frequency is reduced until near zero frequency where natural sources are rare.



NATURAL ducts that can be used for communications purposes with radio and sound waves are found both in the atmosphere and beneath the earth. Sound ducts existing deep in the ocean also offer novel possibilities for long range, point to point communications.



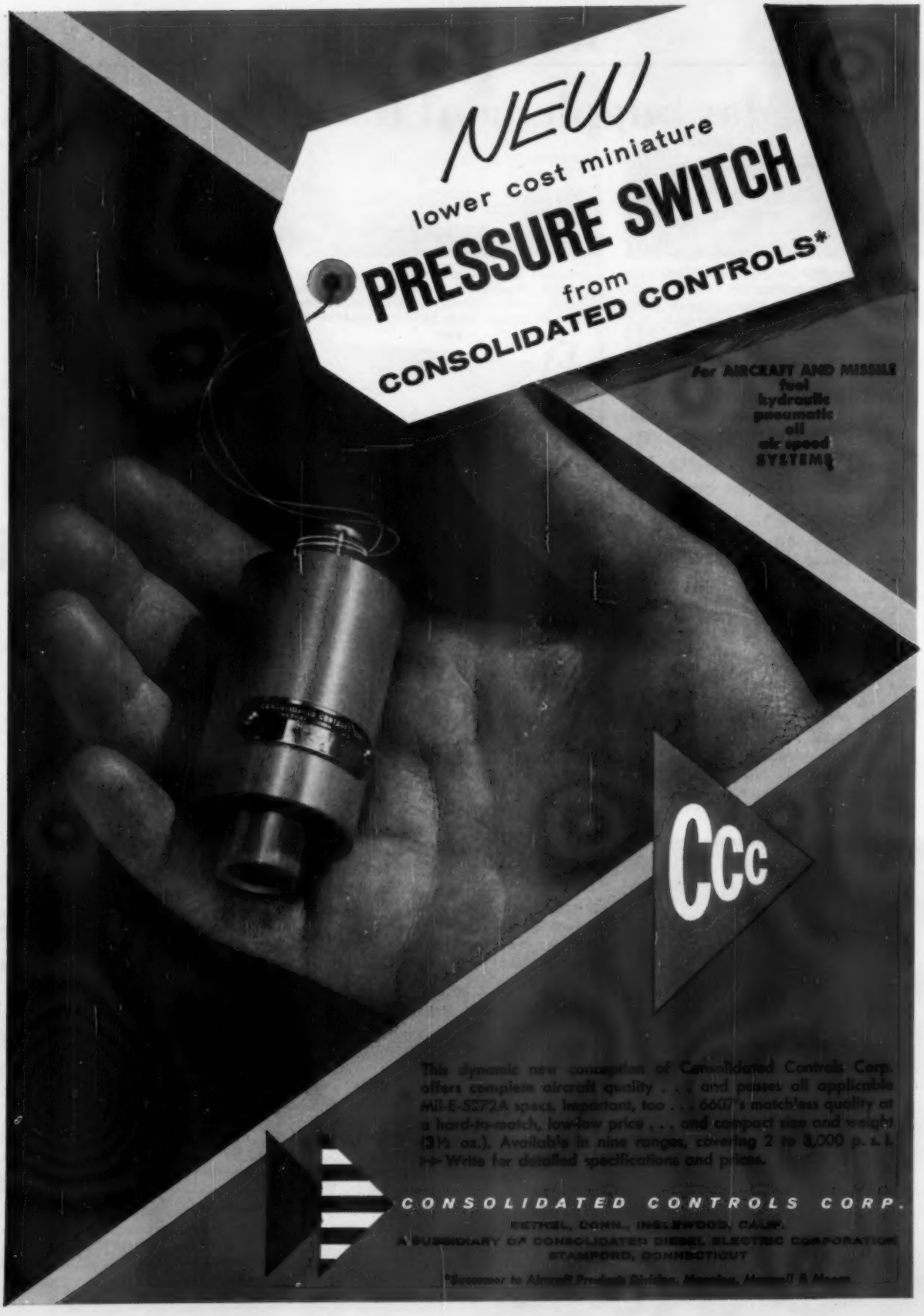
SPHERICAL shells formed within the earth and its atmosphere create these ducts which can be used for long range, low power communications because energy is propagated by inverse first law spreading rather than spherical spreading (inverse square law) from point of origin. Theoretical ideal would be propagation from transmitter to receiver without signal spreading.

Nature has provided a number of media in which propagation occurs by circular spreading or the inverse first law. This happens when the material composing the earth and its atmosphere occurs as spherical shells. Transmission through these natural ducts is very desirable because of the great ranges that can be obtained with low power transmitters.

For example, sound ducts occur in the troposphere at a height of 15 km. and in the ocean at a depth of 1 km. These ducts are caused by refraction or bending of the sound waves toward the center of the duct because the waves at the center travel more slowly than those that deviate from the center. Consequently, a received signal spreads out over a longer time period than is required to transmit it, reducing the speed with which messages can be sent.

Radio waves are ducted within the troposphere by reflection from both the ionosphere and the earth's surface. Also, it is possible to conduct sound and radio waves through appropriate rock strata by reflection from their boundaries, and it is also possible to conduct sound through underground water.

Ducting by reflection from well-defined boundaries causes messages to arrive over individual paths, which means that the same message may be received more than once. This does not limit the message rate to the same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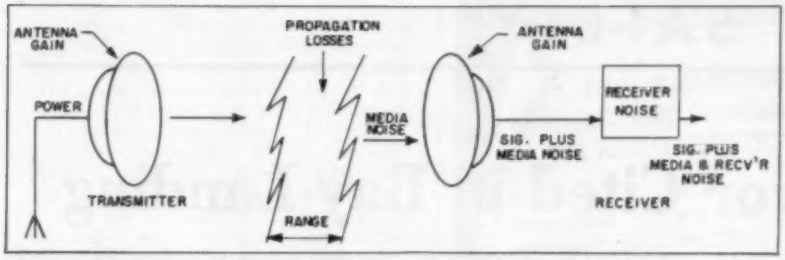


FUNCTIONAL diagram of a general transmitting and receiving system.

extent as through refraction ducts.

One form of ducting where spreading of the transmitted power does not occur is propagation by the "whistler" mode where radio waves of a frequency about 10 kc. are conducted along the lines of the earth's magnetic field far into space, returning to a point in the opposite hemisphere with the same relationship to the magnetic pole.

Absorption of energy by the transmission medium results in a loss which increases exponentially with range in all media and all propagation modes. In general, attenuation per unit range for all forms of propagation is directly proportional to the square of the frequency.

For example, an increase in frequency from one to two kilocycles results in an increase of attenuation by a factor of four. A system having a range of 1,000 km. at one kilocycle will have a range of approximately 250 km. at 2 kc.

The range over which a signal may be transmitted is directly proportional to the power of the transmitter, the gain of the transmitting and receiving antennas, and receiver efficiency.

Sensitivity of the receiver is the minimum power which may be identified as the signal. Sensitivity is limited both by noise present in the medium and noise generated in the equipment. Receiver noise results from thermal vibration of atoms and emission of electronics due to thermal and other causes. Since noise occurs over a wide band of frequencies, it may be reduced by reducing the number of frequencies to which the receiver is sensitive. This group of frequencies, called the band width of the receiver, is directly proportional to the noise power received.

Gain of a receiving antenna has the effect of multiplying the amount of power received in a specific direction. If an antenna receives power equally in any direction, it has a gain of one. An antenna gain of 1,000 would cause the receiver to receive a signal 1,000 times that seen at the antenna. If received power is converted into heat in the antenna, only a fraction of the power would be delivered. This fraction is called the antenna efficiency.

If the results of improving by a factor of 1,000 state-of-the-art sensitivities for signals propagated by inverse square law spreading are compared with inverse first law spreading by duct transmission, significance becomes apparent.

Improving threshold sensitivities for detecting sound in air, supersonic sound in sea and gamma rays by a factor of 1,000 increases the range of the signals less than 5 km. Ultraviolet, infrared and 5 kc. sea sound show improvements of about 50 km. Low frequency radio and low frequency sea sound show an improvement of 5,000 km. In comparison, signals propagated circularly through ducts show much greater improvement. Range of sound at 5 kc. in the ocean is improved by 80 km., sound at low frequencies by 100,000 km. Very low frequency radio is improved by 72,000 km. These figures are based on average power.

The long range potential of low frequency sound in the ocean and very low frequency radio is attractive. However, use of this type of propagation involves the problems of inefficient radiation from small antennas, and transmission of small amounts of information per unit time.

To transmit low frequency sound or radio, the dimensions of an antenna should be comparable to the wavelength, but this is impossible because wavelengths of many kilometers are used for radio and wavelengths of many meters for sound.

Small transmitting antennas can be used if they are surrounded by a small wavelength medium. If the outer surface of the medium is arranged so that excessive reflection of radiation does not occur, transmission of power can be achieved with smaller structures. Experiments with powdered iron have confirmed the theoretical basis for this.

Wavelengths of radio waves that measure 10-100 kc. region are reduced by a factor of more than 1,000 in ferromagnetic materials. Also, greater bandwidth can be achieved with a ferromagnetic antenna than with a conventional antenna with a resulting increase in the rate of information transmission.

As an example, when conventional antennas are used, teletype signals can be generated at the rate of about 40 per sec. at 30 kc. which is equivalent to 120 five letter words per min. A standard teletype can deliver 60 words per minute over this frequency band. If a ferromagnetic antenna is used, the rate would be 2,000 words per min.

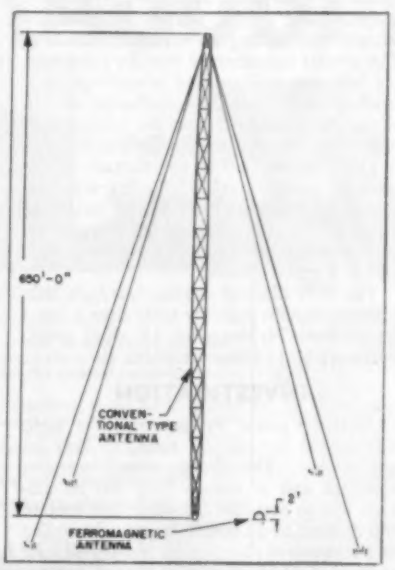
Further experimental data must be obtained before any of the above techniques is utilized because present calculations must be made upon meager data or theoretical extrapolations.

In the case of audible sound, samples of deep rock strata must be obtained to determine its absorption characteristics. Efficient transmitters and receivers must be imbedded in the strata of deep wells to determine the actual ranges of propagation. Further data also must be obtained on the propagation of sound in ducts in the upper atmosphere.

To use effectively the range potentialities of very low frequency radio, smaller and more efficient antennas must be perfected. A thorough study must be made of the concept of using media such as ferrites for construction of these antennas. Additionally, the electrical characteristics of deep rock strata must be obtained to carefully evaluate this medium.

Although ultraviolet may only be used for line of sight transmission because of the lack of ducts, it has a great deal of promise arising from the low background signal. High intensity sources of ultraviolet and suitable modulating equipment should be developed.

A serious disadvantage of these modes of communication (except for ultraviolet) is the excessively narrow bandwidth of the channels. Very low frequency radio has this limitation only because of the inherent properties of present antennas. The intermediate matching media technique suggested could improve this situation. Low frequency sound in sea has non-linear effects in the duct as well as other reverberation sources which also limit the information capacity.



COMPARISON of a ferromagnetic antenna with a conventional vertical antenna.

CAB Accident Investigation Report:

Mechanic's Error Cited in Bay Landing

At 1051[1] on June 21, 1957, a Douglas DC-6A, N 34953, leased and operated by Flying Tiger Line, Inc., made a forced landing, following loss of power on all engines, on a sand bar in Jamaica Bay two miles southwest of its takeoff from New York International Airport. The five flight crew members were uninjured; two of the four company employe-passengers incurred minor injuries. The aircraft received substantial damage from the wheels-up landing and salt water immersion.

HISTORY OF THE FLIGHT

The flight, designated as 8516-21, originated at New York International Airport (Idlewild) and was a ferry flight to Dover, Del. From there the flight was to transport MATS (Military Air Transport Service) freight to Chateau Roux, France. An en route stop and crew change was scheduled at Gander, Newfoundland. An IFR clearance to Dover had been given by ARTC as follows: To the Woolf intersection via the 150-deg. radial of Idlewild VOR and Victor Airway 16, maintain 3,000 ft. The flight crew consisted of Capt. Gregory P. Thomas, Copilot William H. Seamans, Flight Engineer B. J. Palamar and Stewardesses Russon and Johnson.

The takeoff from runway 31R was started at approximately 1048. While climbing at an indicated airspeed of 135 kt., gear up and flaps at the 20-deg. takeoff position approximately over the northwest end of runway 31R, a substantial power loss on No. 3 engine occurred followed immediately by a similar loss on Nos. 1, 2, and 4 engines. Idlewild local control was advised that the aircraft was making an emergency landing. The aircraft was observed to make a descending left turn and to land wheels up on a sandbar in Jamaica Bay southwest of the airport. It came to rest on the fuselage bottom, level laterally and longitudinally.

The gross weight of the aircraft at the time of takeoff was 74,977 lb., which is under the allowable gross takeoff weight of 100,000 lb. (autofeathering inoperative). The load was distributed in compliance with center of gravity limits.

The 1051 Idlewild weather was high, thin scattered clouds; visibility more than 15 mi.; temperature 74; dewpoint 48; wind north-northeast 6 kt.; altimeter 30.06.

INVESTIGATION

After the power loss occurred, the flight was cleared by Idlewild tower to land on any runway. The aircraft passed near the approach end of runway 13R but its altitude was so low that a further left turn to the runway could not be made. According to testimony of the captain, it was necessary to go straight ahead with the small amount of power remaining and he was unable to maintain altitude at an airspeed of 105 kt. The landing, with gear up and flaps fully extended, was made on a heading of approximately 200 deg. magnetic off the east shore of an island in Jamaica Bay.

Statements of the flight crew indicated that a normal engine runup had been made at 30 in. of manifold pressure and all pressures and temperatures were normal. In accordance with the Flying Tiger operations manual, a wet takeoff was made using 2,800 rpm., 59.5 in. of manifold pressure, and 240 BMEP. After breaking ground and reaching an altitude of about 140 ft. over the end of runway 31R, the BMEP of No. 3 engine dropped to 105, followed by a similar drop on the other three engines. A reduction of manifold pressure to 50 in. did not correct the difficulty and it was returned to 59½ in. The continuing loss of power, drop of airspeed to 105 kt., and low altitude precipitated the forced landing.

Because of the nearly simultaneous loss of power on all four engines, initial investigation was directed to the aircraft's fuel supply. Board investigators immediately obtained samples of gasoline and ADI (antidetonant injection) fluid from the aircraft. Samples were also obtained at the supply source of the Flying Tiger Line. The samples of gasoline were analyzed and found to be the correct octane rating (108-135) and uncontaminated. Laboratory analysis of the samples taken from the ADI tanks of the aircraft revealed 55% of 50/50 methanol-water contaminated with 45% of ethylene glycol. The 50/50 methanol-water is the correct ADI fluid while ethylene glycol is a fluid used to eliminate ice accretion on the exterior surfaces of aircraft.

Investigation disclosed that N 34953 had arrived from an overseas trip the evening of June 20 and that the aircraft was serviced the morning of June 21. Fuel was added to the four main tanks only. The aircraft's four ADI tanks were filled by a mechanic using a portable cart holding a 55-gal. drum marked "ADI." Samples taken from this cart disclosed the fluid to be entirely ethylene glycol.

Investigation further disclosed that the ADI servicing cart had been replenished, the late afternoon of June 19, from a fenced drum-storage area outside of the Flying Tiger hangar on New York International Airport. It was found that there were drums containing various liquids intermingled in this storage area. Among these liquids were both ADI fluid and ethylene glycol. All of the drums were marked on one end as to the contents. However, the method of filling the portable cart was to insert a hand pump at a side bung in the drum where there were no markings. A deposition taken from the uncertificated mechanic who had serviced the cart June 19 indicated that he had mistakenly filled the cart from a drum of ethylene glycol. This mechanic also indicated to Board investigators the drum used to fill the ADI cart. The stenciling on the end of this drum, while dirty and blurred, was distinguishable as indicating the contents to be ethylene glycol. The mechanic stated that he had previously serviced the ADI cart but that he had never had occasion to draw other fluids at the outdoor source of supply.

An examination of all engines at the sand bar disclosed no evidence of structural failure or malfunction. All four engines were subsequently shipped to the Flying Tiger base at Burbank, Calif. Under supervision of Board personnel a cylinder from each row of the No. 1 engine was removed for examination. No evidence of operational failure was found. The articulating assemblies, master rod, and main bearings were intact and adequately lubricated. Rotation of the propeller shaft revealed normal gear train action throughout the entire engine. A concentricity check was made on the propeller shaft and found to be within limits.

After reassembly, the No. 1 engine of N 34953 was installed on an engine test stand for the purpose of checking its performance under dry power as well as wet power with a similarly contaminated ADI mixture as was found on the subject flight. New spark plugs were installed because of salt water corrosion and fouling of the original plugs. Nothing else was required.

The engine was then started and operated at idle power until temperatures and pressures stabilized. The engine was operated at 1,000, 2,100, 2,300, and 2,600 rpm. at dry power, at which times pressures and temperatures were normal. During these runs the ignition analyzer indicated normal ignition patterns on all cylinders. The engine was then operated without water injection (ADI) at takeoff power (2,800 rpm.; 60 in. manifold pressure) and a torque meter pressure of 132 lb. was recorded. This is equivalent to 238 BMEP or 2,350 hp. Temperatures and pressure were within normal limits.

Contaminated Mixture

The ADI tank was then serviced with a mixture of 55% of 50/50 methanol-water and 45% of ethylene glycol. The ADI system was checked and found to function normally at 2,400 rpm. and 45 in. manifold pressure. However, at this time the ADI fluid was not permitted to enter the cylinders. Power was then advanced to wet takeoff figures (2,800 rpm. and 62 in. manifold pressure) and a torque pressure of 132 lb. (equivalent to 238 BMEP) was recorded.

The contaminated mixture was then allowed to flow and approximately 40 sec. later the color of the exhaust flame changed from whitish-blue to deep orange; the torque pressure dropped immediately to 70 lb. and

[1] All times herein are eastern daylight and based on the 24-hr. clock.

the cylinder head temperatures rose rapidly to the top limit of the instrument (+300C). The maximum allowable cylinder head temperature at takeoff is 260C. The ignition analyzer indicated a progressive fouling of the spark plugs in all cylinders. A drop in torque pressure from 132 lb. to 70 lb. (equivalent—238 BMEP to 127 BMEP) would be a drop in horsepower from approximately 2,350 to 1,225.

After the full power test the engine was operated at dry power for 45 sec. but the torque pressure did not improve appreciably. Cylinder head temperatures remained above the maximum limits.

After the salvaging of the aircraft and the installation of four other powerplants, a test flight reflected full and normal operation of the aircraft's fuel and water injection systems.

It was noted during the investigation that the usual air carrier standards in the storing, marking and servicing of various aircraft fluids were not in effect at the Flying Tiger Idlewild hangar. The assigning of personnel to fill the ADI servicing cart was entirely haphazard.

ANALYSIS

Based on the evidence disclosed during the investigation of this accident, the Board has conclusively proved that the engine power loss was the result of contaminated ADI fluid in the engines. Tests duplicating the situation showed that the continuing and increasing power loss experienced during the flight precluded continued flight. In this regard, the Board believes the pilots met the serious situation ably and did all that was possible under the conditions. In fact, the pilots are to be commended for their action in avoiding populated areas and making the landing on an isolated sand bar.

Had the engines been run up on the pretakeoff check approximately 40 in. of manifold pressure, ADI fluid would have started to flow and its effect would probably have been detected by the crew. However, it is normal procedure to check magnetos at atmospheric pressure (approximately 30 in.) and complete the runup at about this manifold pressure to preclude a rise in cylinder head temperature.

The Board is of the opinion that the mechanic mistakenly filled the ADI cart with ethylene glycol. The mechanic should have been able to read the markings on the drum and, before filling the ADI cart, he should have made certain as to the contents of the drum used.

It is apparent that a serious lack of managerial supervision was also involved. The drums should have had additional markings indicating the contents placed at the side bung by FTL maintenance. It is further evident that a separation of the drums in a more orderly manner would have assisted in preventing the mistake that occurred. Finally, it is the Board's opinion that there was a definite lack of instruction for the mechanics servicing the ADI cart.

Subsequent to this accident, the supplier took steps to stencil the initials "ADI" above the side bung on drums that are equipped with a side bung. In addition, the air carrier has revised its maintenance manual instructing its personnel to segregate ADI fluids from other fluids and to discharge a slight amount of fluid over their hands be-

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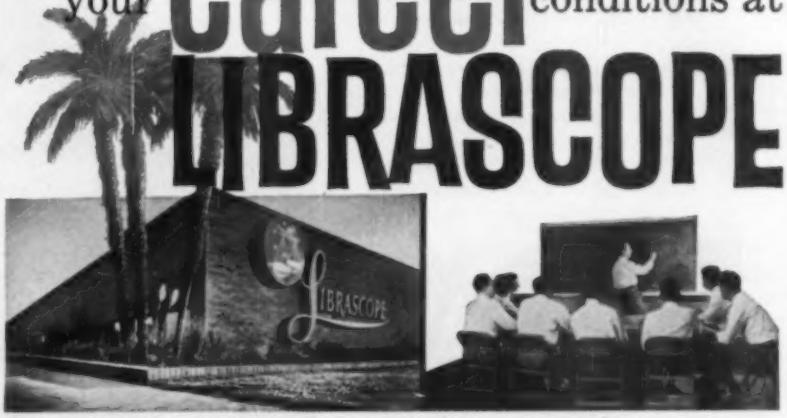

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fore servicing an aircraft to determine if the fluid is contaminated.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft and the crew were currently certificated.
2. The gross load of the aircraft was under the allowable gross weight.
3. A wet takeoff (i.e., the ADI switches were actuated) was made in accordance with FTL operations manual.
4. The fluid in the aircraft's ADI tanks consisted of 55% methanol-water (correct ADI fluid) and 45% ethylene glycol.
5. The use of this mixture for takeoff caused a nearly immediate loss of power in all engines and precipitated the forced landing.
6. The ADI fluid service cart used to service N 34953 was mistakenly filled, by a mechanic, with ethylene glycol.
7. The cart was serviced at a common uncovered storage area where drums containing glycol, ADI fluid, and other liquids were intermingled.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the loss of power on all engines immediately after a wet takeoff due to (A) contamination of ADI fluid resulting from (B) mechanic's mistake in replenishing ADI supply cart with ethylene glycol (de-icing fluid), and (C) inadequate supervision of storage facilities.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

SUPPLEMENTAL DATA

Personnel of the New York office of the Civil Aeronautics Board heard and observed the takeoff of N 34953 over their building. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions, ordered by the Board, were taken at New York International Airport on July 10 and 17, 1957.

AIR CARRIER

Flying Tiger Line, Inc., is a Delaware corporation with its principal offices at Burbank, Calif. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to engage in air transportation between various points in the United States and foreign countries. The subject flight was under a military contract Air Force 33/600/34320.

FLIGHT PERSONNEL

Capt. Gregory P. Thomas, age 43, was employed as a pilot by Flying Tiger Line in 1950. He held an airman certificate with airline transport rating and type ratings on DC-3, DC-4, DC-6, DC-7, C-46, and Constellation aircraft. He had, according to records, a total of 13,000 pilot hr. of which 300 were acquired in DC-6 aircraft. His last six-months proficiency check was on Feb. 10, 1957.

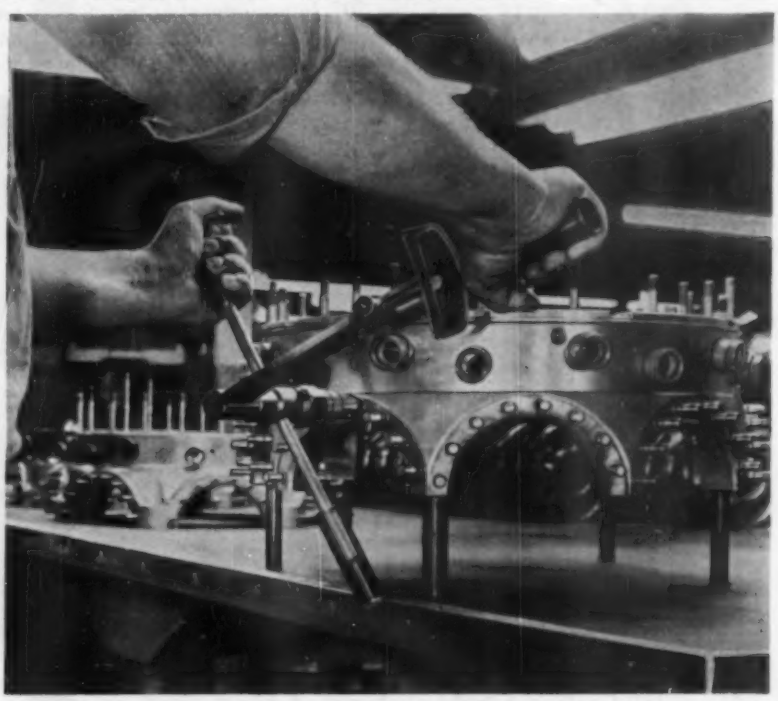
Copilot William H. Seamans, age 42, was employed by Flying Tiger Line in 1952. He held an airman certificate with airline transport rating and type ratings on DC-4 and C-46 aircraft. He had, according to company records, a total pilot time of 14,000 hr., of which 80 hr. were acquired in DC-6 aircraft. His last six-months' proficiency check was on June 7, 1957.

Flight Engineer B. J. Palamar, age 30, was employed by Flying Tiger Line in 1956. He held an airman certificate with rating of flight engineer and had a total flying time, according to company records, of 750 hr., of which 500 were acquired in DC-6 aircraft. His last flight engineer proficiency check was on March 28, 1957.

THE AIRCRAFT

Douglas DC-6A, N 34953, serial number 44677, was manufactured Nov. 18, 1954. It was owned by the Main-Elford Corp. and leased to Flying Tiger Line, Inc. Total time on the aircraft was 9,922 hr., with 38 hr. since maintenance operations No. 5. The aircraft was equipped with four Pratt and Whitney CB-17 engines and four Hamilton Standard model 43E60-375 propellers, blade model 6895E-8. Total time on the four engines was between 5,843 and 9,102 hr., and between 271 and 1,020 hr. since last overhaul.

Total time on the four propellers was between 661 and 15,479 hr., and 459 and 2,462 hr. since last overhaul or new.



THE WAY OF A MAN WITH A NUT

. . . has a lot to do with the cost of an engine overhaul . . . and its quality. If he uses nut runners, the cost goes down. If he uses nut runners on precision jobs, the cost goes further down—and the quality with it.

It still requires work, skill and integrity to properly overhaul an engine. Airwork uses nut runners to start the job . . . torqued wrenches to finish it. Cylinder hold down nuts are hand torqued, backed off and re-torqued to make sure an accurate "value" has been obtained.

Airwork's philosophy of overhaul constantly balances time savings against the ultimate effect on engine-hour operating cost. This philosophy is an insurance policy, working in your favor.

More than 300 large corporation fleets find it easy to justify Airwork overhauls on a total operating cost basis. Contact your nearest Airwork branch office for full information. See the Yellow Pages for telephone number.

Airwork CORPORATION
Millville, New Jersey

BRANCHES IN:
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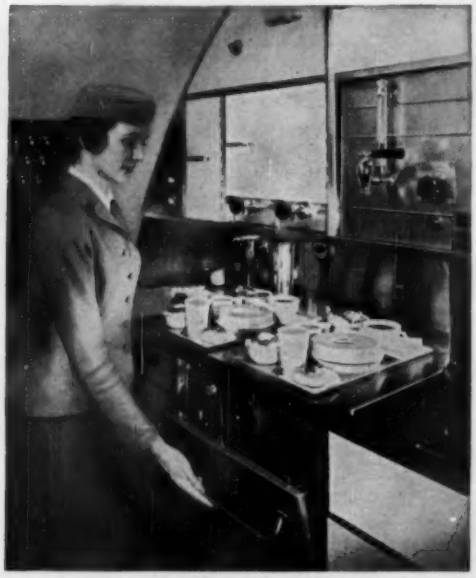
THE BOEING 707 STRATOLINER (above) is designed for medium to long-range routes; the 707 Intercontinental, for over-ocean routes, and the 720 for short-to-medium range routes. All will bring unprecedented passenger comfort to the world's airlanes.

PASSENGERS WILL RELAX in luxuriously comfortable cantilevered chairs that provide unobstructed leg room. Built-in opaque window shades will cut any undesirable glare.



GALLEYS ARE LOCATED both forward and aft for efficient, flexible food service for up to 189 passengers. On ground, galleys are quickly serviced through special hatches.

IN SPACIOUS 707 AND 720 CABINS, passengers will enjoy a ride totally free of fatigue-inducing vibration. At night, ovalled dome lights create the illusion of star-flecked sky. Windows—twice as many per seat row as in conventional airliners—provide unobstructed view even from aisle seats. Overhead passenger service units contain reading lights, call buttons, individual speakers. Ventilation system changes air rapidly without draft. Movable bulkheads and seats set in tracks can be changed to any combination of 4, 5 or 6-abreast seating to meet all competitive situations.

707 AND 720 CABINS provide for club-like lounges forward and aft. They can be replaced by additional seating. Boeing jetliners combine passenger-pleasing luxury with economical flight and maintenance features that add up to profitable operations for airlines.

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WHO'S WHERE

(Continued from page 23)

Honors and Elections

The U. S. Navy has honored the following executives of Sanders Associates, Inc. and Raytheon Manufacturing Co. "for outstanding contributions to the National Defense in the fields of scientific research and development and missile guidance technology." Sanders Associates, Inc.: **Royden C. Sanders, Jr.**, president, recipient of the Distinguished Public Service Award; **Martin R. Richmond**, executive vice president, and **William Ralph Mercer**, director of research, recipients of Meritorious Public Service Citations. Raytheon Manufacturing Co.: **T. C. Wisenbaker**, assistant manager-Missile Systems Division, **Thomas L. Phillips**, manager and chief engineer-Bedford, Mass., laboratory, and **Joseph H. Leiper**, manager-Oxnard, Calif., laboratory, recipients of Meritorious Public Service Citations.

Changes

Brig. Gen. William L. Rogers, former assistant for development planning in the office of Deputy Chief of Staff for Development, has replaced Brig. Gen. E. L. Sykes as vice commander of the Air Force Missile Test Center, Fla.

Col. Benjamin S. Mesick (USA, ret.), assistant to the president, Grand Central Rocket Co., Redlands, Calif.

George H. Hauser, assistant to the president, Republic Aviation Corp., Farmingdale, N. Y.

Richard L. Spaulding, assistant to the president, Babb Company, Inc., New York, N. Y.

W. A. Carr, director of sales-Eastern Region, American Airlines, Inc.

Paul Yavorsky, technical director, Zirconium Corporation of America, Solon, Ohio.

Sidney Stark, operations manager for the Pershing missile, the Martin Co.'s Orlando, Fla., guided missile and electronics center; **Dr. Henry M. Watts**, chief engineer.

Kenneth M. Lord, director of engineering, Electronics Division, Stromberg-Carlson, Rochester, N. Y.

R. W. Young, general manager, and **H. H. Michaels**, assistant general manager, Reaction Motors Division of Thiokol Chemical Corp., Denville, N. J. Also: **J. W. Antonides**, director of the X-15 program and assistant to the general manager; **D. C. Eaton**, director of marketing; **D. F. Floris**, director of engineering; **F. D. Pfopenhauser**, director of production; **Dr. E. H. Seymour**, director of research.

T. R. Pierpoint, manager-military programs, and **Bruce McKay**, manager-general products, Government Operations Division, Vertol Aircraft Corp., Morton, Pa.

John T. Bailey, chief design engineer, Vitro Engineering Co., division of Vitro Corp. of America, New York, N. Y. Also. **Robert W. Dillon**, West Coast sales representative, Vitro's weapon systems group.

Dr. Louis Malter, director of central research, Varian Associates, Palo Alto, Calif.

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Part Time Work	Selling Opportunities Offered	Labor Bureaus

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Air Commerce Consultant wanted by New York State Department of Commerce. Salary Range $8750 to $10,520. Civil Service examination to be held June 21, 1958. Write to NYS Department of Civil Service, Albany 1, New York before May 23 for detailed announcement and application forms.

Helicopter Mechanics—With experience on bell helicopters. Both domestic and foreign assignments. Helicopter Surveys, Inc., P. O. Box 186, Sta. B., Bakersfield, Calif.

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ATR Pilot, Lodester, DC-3, Twin-Beech, 6000 hrs sched. air-carrier, USAF, and recently Executive. No accidents No Violations. College Educ. in Engrg; Mechanical exper. Excel. References, 37, Family. Resume on request. PW-7972, Aviation Week.

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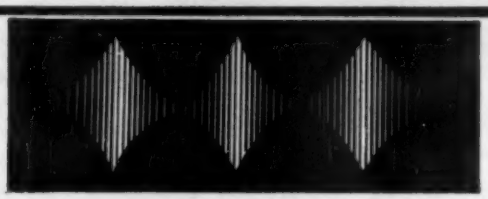
For sale, 2 1956 310's, low A&E time-completely equipped, including auto-pilot, etc, beautiful condition. Call North Atlantic Airways, Beverly, Mass.—Walker 2-6536.

Communications equipment manufacturer has surplus inventories of new prime quality electronic components for sale at attractive prices. Write FS-7945, Aviation Week.

For Sale A-26 Remanufactured April 1953 1800 hrs total time Airframe 360 hrs SMOH R. E. 75 hrs SMOH L. E. Two tone green & white exterior, brown & tans interior A-12 auto-pilot complete Dual Collins omni & 17L xmtn 360 channel collins communications Collins glide slope Bendix MKR isolation Amplifiers & speakers 10 channel MHF transceiver. Spare engine completely built up for quick change many other spares. Price complete $168,500.00. Mi 4-5366, Reg. Robbins, Municipal Airport, Houston, Tex.



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Missile System Development Group Leaders: Low noise receivers, pulse transmitters, broad band techniques, antenna arrays, phase measurement and other instrumentation.

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Sr. Microwave Engineer: Development of crystal mixers, detectors, filters, transmission line couplers, harmonic generators and special transmission circuits.

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ELECTRONIC SYSTEMS DIVISION

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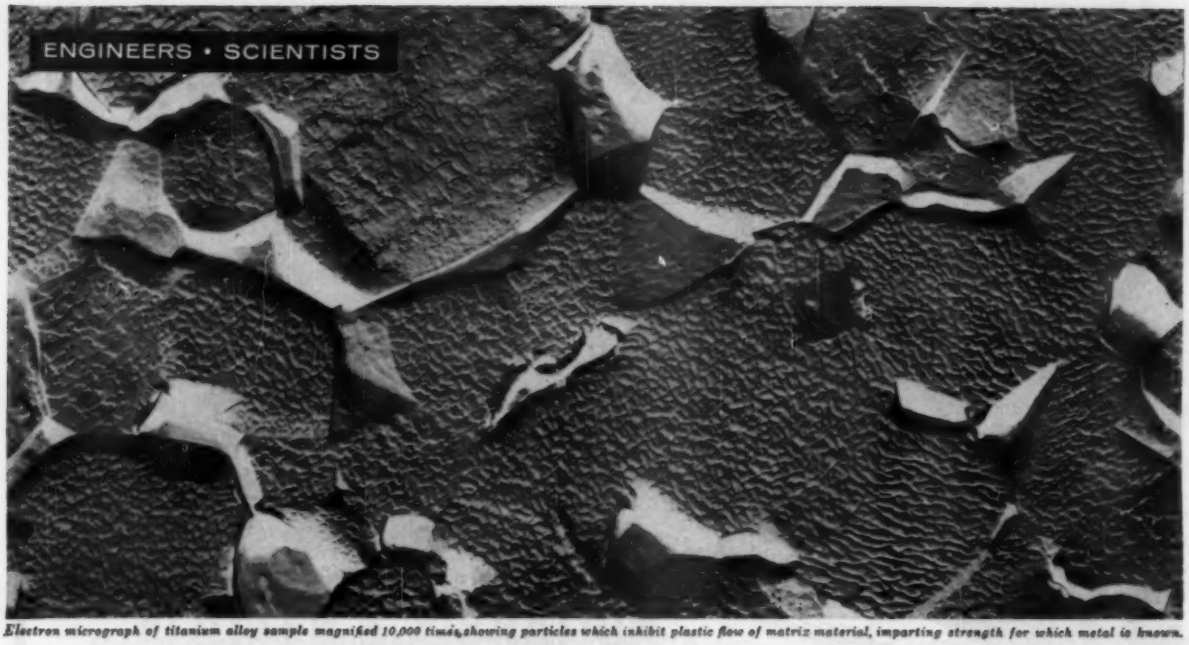

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Engineering Employment Manager

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Openings for engineers with 4-10, or more, years' experience in:

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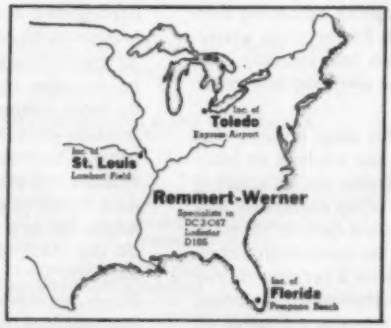

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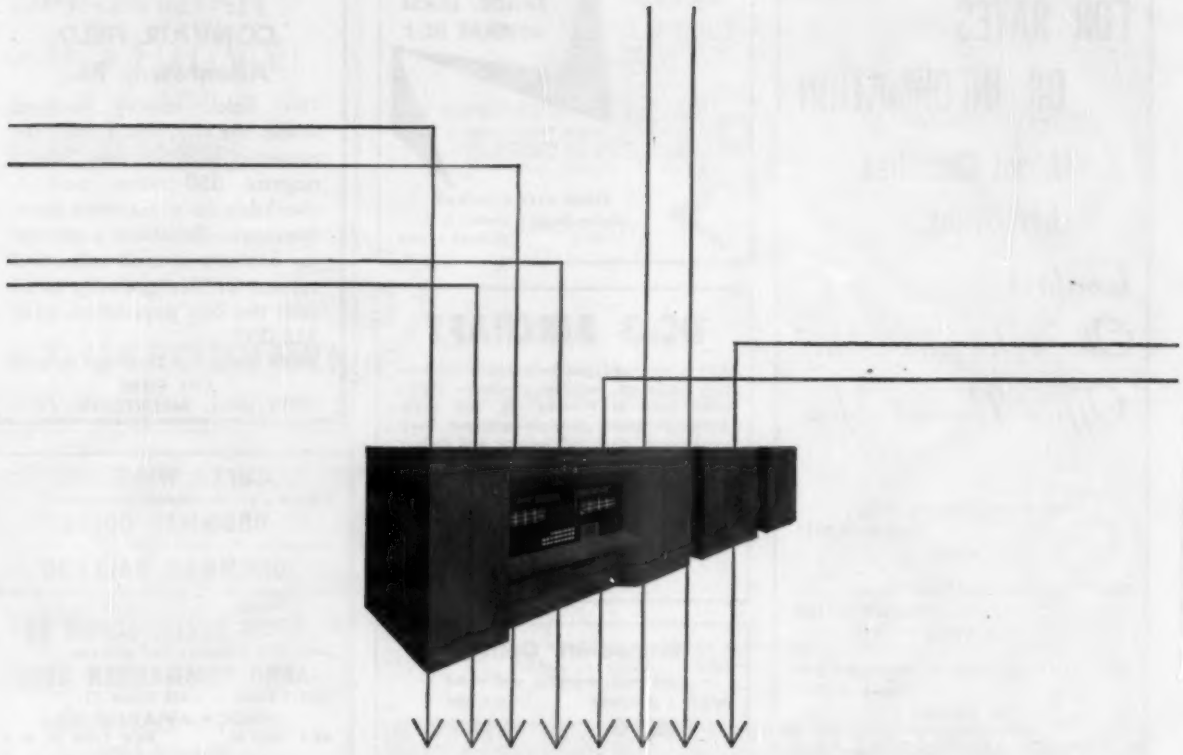

The ORGANIZATION and RETRIEVAL of INFORMATION

The organization and retrieval of large volumes of diverse types of information is rapidly becoming one of today's more serious problems. Major areas where the problem exists include business and industry, the military, the government, and the scientific and engineering community itself.

In its simpler forms, the problem may involve, for example, the automatic handling and analysis of business data such as payrolls, sales and manufacturing figures, insurance premiums, and other essentially statistical data. At the other extreme are certain complex military situations which require the concurrent interpretation, analysis, and integration on a very short time scale of data from a wide variety of sources, including field reports, photographs, news reports, estimates of industrial activity, and the like. In many of these situations, there is the additional requirement to translate the information from a foreign language into English.

The development in recent years of electronic data handling equipment is now making possible the practical solution of many of these problems. Such equipment has the capability to perform arithmetic operations, make decisions among alternatives, store and retrieve large quantities of information, and at high speed automatically perform long, complex sequences of operations.

At Ramo-Wooldridge, work is in progress on advanced information handling systems that are characterized by large volume and widely different forms of information, short time scales, and a variety of uses and users. The scope of the work includes the planning of systems and procedures, programming various types of data handling equipment, and formulation of requirements for new equipment. Research is also under way on the machine translation of foreign languages into English.

Engineers and scientists with experience in the following fields are invited to explore the wide range of openings now available:

- Systems Engineering
- EDP Systems
- Computer Programming
- Console Design
- Display Development
- High Acuity Optics
- Photo Interpretation

The Ramo-Wooldridge Corporation

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, MAY 19, 1958

AIR ASSOCIATES, A DIV. OF ELECTRONIC COMMUNICATIONS INC. 93
Agency—Alfred L. Lino & Assoc.
AIRCRAFT RADIO CORPORATION 8-9
Agency—Burke Dowling Adams, Inc.
AIRWORK CORPORATION 103
Agency—Gene Wyble Advertising
AMERICAN WELDING & MFG. COMPANY 7
Agency—The Bayless Kerr Co.
AMPHENOL ELECTRONICS CORPORATION 72
Agency—Burton Browne Adv.
ANDREA RADIO CORP. 82
Agency—Dowd, Redfield & Johnstone, Inc.
AVIATION WEEK 90-91

BELL AIRCRAFT CORPORATION 90
Agency—Baldwin, Bowers & Strachan, Inc.
BELL HELICOPTER CORPORATION 66
Agency—Rogers & Smith Adv., Inc.
BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. ..... 3rd Cover
Agency—MacManus, John & Adams, Inc.
BILTMORE HOTEL, THE 83
Agency—Koehl, Landis and Landan, Inc.
BOEING AIRPLANE COMPANY 104
Agency—Calkins & Holden, Inc.

CONSOLIDATED CONTROLS CORP. 96
Agency—DeGarmo Inc.
CONSOLIDATED DIESEL ELECTRIC CORP. 84-85
Agency—DeGarmo Inc.
CONSOLIDATED ELECTRODYNAMICS CORPORATION 63
Agency—Hixson & Jorgensen, Inc.
CONTINENTAL AIRLINES, INC. 48-49
Agency—J. Walter Thompson Co.

DAYSTROM TRANSICOIL CORP. 88
Agency—The Harry P. Bridge Co.
DOW CORNING CORPORATION 86
Agency—Church & Guisewite, Inc.

EASTERN INDUSTRIES INC. 22
Agency—Remsen Adv., Inc.
EITEL-McCULLOUGH INC. 15
Agency—Evans, McClure & Associates
ERCO NUCLEAR PRODUCTS DIV., ACF INDUSTRIES, INC. 35
Agency—Conti Adv. Inc.
ESSO EXPORT CORPORATION, AVIATION PRODUCTS 102
Agency—McCann Erickson, Corp.
ETHIOPIAN AIRLINES, INC. 83
Agency—St. Georges & Keyes, Inc.

GARLOCK PACKING CO., THE 92
Agency—Hutchins Adv. Co., Inc.
GARRETT CORPORATION—AIRESEARCH MFG. DIVISION 56
Agency—J. Walter Thompson Company
GENERAL ELECTRIC COMPANY 58-59, 69
Agency—G. M. Basford Company
GENERAL ELECTRIC COMPANY, TUBE DIVISION 73
Agency—Maxon, Inc., Adv.
GENERAL ELECTRIC COMPANY (HMEE) 90
Agency—Deutsch & Shea
GOODRICH COMPANY, THE B. F. 20
Agency—Batten, Barton, Durstine & Osborn, Inc.

HARNISCHFEGER CORPORATION, WELDING DIVISION 67
Agency—Hoffman & York, Inc.
HYATT BEARINGS DIVISION, GENERAL MOTORS CORPORATION 13
Agency—D. P. Brother & Company
HYDRO-AIRE INC. 3
Agency—Gaynor & Ducas, Inc.

KELSEY HAYES COMPANY 54
Agency—Zimmer, Keller & Calvert Inc.

LIBRASCOPE, INC. 99
Agency—Compton Advertising, Inc.
LINK AVIATION, INC. 100-101
Agency—Gaynor & Ducas, Inc.
LOCKHEED AIRCRAFT CORPORATION 46
Agency—Foote, Cone, Belding Adv.
LORD MFG. COMPANY 12
Agency—The Jayme Organization, Inc.

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC. 16
Agency—Kolb & Abraham Inc.

NAPIER & SON, LTD., D. 44
Agency—C. R. Casson Ltd.
NEW DEPARTURE DIVISION—GENERAL MOTORS CORPORATION 52
Agency—D. P. Brother & Company
NICHOLS COMPANY, W. H. 57
Agency—Chambers, Wiswell, Shattuck, Clifford & McMillan, Inc.
NORTH AMERICAN AVIATION, INC., AUTONETIC DIV. 105
Agency—Batten, Barton, Durstine & Osborn, Inc.
NORTH AMERICAN AVIATION, INC., L. A. DIV. 113
Agency—Batten, Barton, Durstine & Osborn, Inc.

PACIFIC DIVISION—BENDIX AVIATION CORPORATION 17
Agency—The Shaw Company Adv.
PHELPS DODGE COPPER PRODUCTS CORP. 74
Agency—Compton Adv., Inc.
PRATT & WHITNEY DIVISION, UNITED AIRCRAFT CORPORATION 64-65
Agency—Lennen & Newell, Inc.

RAMO-WOOLDRIDGE CORPORATION 112
Agency—The McCarty Company
REYNOLDS METALS COMPANY ..... 4th Cover
Agency—Clinton E. Frank, Inc.
RHEEM MANUFACTURING COMPANY ..... 2nd Cover
Agency—Getz & Sandborg, Inc.
ROBINSON AVIATION INC. 60
Agency—Platt & O'Donnell Adv., Inc.
ROCKBESTOS PRODUCTS CORPORATION 6
Agency—Sutherland Abbott
ROHM & HAAS COMPANY 36
Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc.
ROTOL, LTD. 14
Agency—Gaynor & Ducas

SARGENT ENGINEERING CORPORATION 4
Agency—Darwin H. Clark Company
SOLAR AIRCRAFT COMPANY 82
Agency—The Phillips-Ramsey Company, Inc.
SOUTHWEST AIRMOTIVE CO. 80
Agency—Don L. Baxter, Inc.
SPERRY GYROSCOPE COMPANY—DIV. OF SPERRY RAND CORPORATION 94
Agency—Reach, McClinton, Inc.
STALKER DEVELOPMENT CO. 83
Agency—H. M. Foehl Assoc.
STAVID ENGINEERING, INC. 24
Agency—Gaynor & Ducas, Inc.
STEWART & STEVENSON SERVICES 78
Agency—Rives, Dyke & Co.

TEMCO AIRCRAFT CORP. 10
Agency—Rodgers & Smith Adv.
THOMPSON AIRCRAFT TIRE CORPORATION 11
Agency—Norton M. Jacobs Adv. Agency
TIMKEN ROLLER BEARING COMPANY 76
Agency—Batten, Barton, Durstine & Osborn, Inc.
TRANS-SONIC, INC. 8
Agency—Louis K. Frank Co.
TURBO PRODUCTS, INC. 47
Agency—Steller, Millar, Lester, Inc.

VICKERS, INC., DIVISION OF SPERRY RAND CORPORATION 18
Agency—Witte & Burden Adv.

WESTINGHOUSE ELECTRIC CORPORATION 70
Agency—Fuller & Smith & Ross, Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 106-110
BUSINESS OPPORTUNITIES Offered 111
EQUIPMENT (Used or Surplus New) For Sale 110-111

ADVERTISERS INDEX

Ambrose Aviation Co., Frank 110
City of Allentown, Pa. 111
Collins Engineering Corp. 111
Engine Works 111
Farrar Aviation 110
General Electric Co.,—ANPD CHRISTOS 106
General Electric Co.,—MDSS KINSELLA 109
International Aircraft—Maintenance Co. 110
Lund Aviation (Canada), Ltd. 111
Rommert-Werner Inc. 111
Republic Aviation Corp (Hickman) 108
Stanford Research Institute 110
Sylvania Electric Pro. Inc. (Waltham) 107
Trade-Ayer Company 111
United States Overseas Airlines 111
Welsch Aviation Company 111

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He'll calculate and measure sound levels for consulting on procedures to insure crew comfort and efficiency; and work out sound environment problems on equipment of particular airframes and structural fatigue problems resulting from high acoustical levels.

There are also challenging opportunities for less experienced acoustical engineers.

Write to: Mr. A. E. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

LETTERS

Spitfire Data

I am compiling all the data on the Supermarine Spitfire fighter used by the RAF throughout World War II, with the view of having it all published in a book at some future date.

However, this famous aircraft also saw service with the USAAF in considerable numbers, initially with the three "Eagle" squadrons of the RAF (later becoming the 4th Fighter Group, 8th Air Force), and also with the 31st and 52nd Fighter Groups in North Africa. Also used by the AAF was the photo-reconnaissance version, the Mark PR. 11, concerning which I have no information except one small photo.

Any details on the following would be most helpful:

1. Numbers and types (Mark numbers) of Spitfires/Seafires supplied to, or used by the USAAF or USN.

2. Where used, and any operational histories of individual aircraft, units or personnel involved.

3. Details of squadron insignia, color schemes and serial numbers.

4. Any photographs or negatives would be most welcome and will be treated with great care, and returned if required.

Congratulations on a most excellent magazine. The article on radar countermeasures some months ago (Nov. 18, p. 50 and Nov. 25, p. 102) was particularly well written and most informative.

TED HOOTON
34 Minnacote Ave.
West Hill P. O.
Ontario, Canada

Idea Salesmen

I believe the letters on the "engineering shortage" in the Jan. 27 issue of AVIATION WEEK (p. 122) represent a condition which is general throughout the country; spokesmen for management say there is an engineering shortage while most engineers say there is not.

Management believes that most graduate engineers do not have the creative, imaginative and inventive ability which is required for the important engineering jobs, while most engineers believe they have these abilities but are continuously being frustrated in their attempts to demonstrate them.

If both sides are being honest, it is obvious that engineers do have abilities which management is not aware of. Can such a thing be? Is it possible that with all the money and effort being spent to unearth engineering talent management has let much of it slip through its fingers?

My answer is yes and my explanation follows.

The product of creative, imaginative, and inventive ability is new ideas, but a new idea is the hardest thing in the world to sell. In addition, the average engineer who has a new idea is probably the world's worst salesman. His education and experience have taught him to make accurate statements of fact and to be conservative where doubt exists. The salesman, on the other hand, is trained to use words to create an impression. Accuracy of statement is of no concern to him, and doubt is something to be counteracted by more extravagant claims.

Management people have much more experience with the salesman type language than with the engineering type, so engineers are judged by the impression they make long before they have a chance to demonstrate the qualities which make them good creative engineers. There is no shortage of good engineers, but there probably is a shortage of good engineers who are also good salesmen.

CHARLES E. CASAD
General Electric Co.
Merced, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Instructors' Plight

Reading AVIATION WEEK editorials has given me a complex. Since 1940 I have had a smug feeling of superiority when a ground soldier would come out with the statement that "it is still the infantry that occupies and holds a territory." Now I'm getting that "shoe on the other foot" feeling. This playing underdog to a missile brings out a defensive attitude among the flyboys, so I'm going to bat for them.

First a word to the missile men. Get at it fellows; firewall your program; now that Wilson is gone you only have the Russians' competition to get past. Now to you other guys that disperse the tax money, before you put the old fire horse out to pasture you better keep him fat and healthy until you are sure he won't be needed. Manned aircraft will have a big gap to fill for some time.

The Air Force is a big organization. I'll just dwell a bit on that least publicized part of the training program, the Primary Flying School.

For nearly 20 years I have had first-hand association with the men and the civilian contract schools that teach our pilots. Occasionally it leaks out that these contract schools do an excellent job at about one third the cost of previous methods. That means fewer men are doing the same job for less money.

It means they have done the U.S. a great service in military preparation and saving the taxpayers money.

The civilian flight instructor at these contract schools flies Air Force aircraft, works in conjunction with rated Air Force pilots, takes the same physical exams, teaches Air Force students (often officers getting more pay than their instructor), teaches out of Air Force Flight Manuals, undergoes constant upgrading and standardization, works under the pressures of scheduling, bad weather and twofold responsibility to the contractor and to the Air Force. Yet, he does it with ever increasing records of efficiency and safety. He is a professional man doing the job he likes, but like the school teacher it hurts him to see the fruits of his labors go unrecognized. He sees the pay scale of the military and of sundry civilian jobs go up all around him. He feels the bite of inflation. He remembers men he knew who lost their lives in their work, others who lost their jobs for any one of the many possible reasons, i.e. a punctured eardrum, a bad eye or when a whole school just closes and leaves him high and dry. The civilian instructor is doing difficult work, highly frustrating, and often fatiguing to the point of breakdown. He is doing a job requiring great experience, understanding and ability.

Yet to date the country and the government choose to accept his efforts with little acclaim.

We here at Moore Air Base, Mission, Texas, are all eagerly awaiting the accelerated T-37 jet program which is being enacted. It will again mean stepping into a faster aircraft, learning a thousand new details, new procedures, methods, high altitude, high speeds, much study and upgrading on our own time, more stringent physical exams and probably more risk. Yet these men are a hardy lot and will do the same excellent job in the future they are now doing.

For their personal motivation and for those who have put in years of faithful service in the past as civilian contract flight instructors, it would be nice to know that Congress was pulling a bill out of a dusty pigeonhole that would at least afford these men something equivalent to the G. I. Bill of Rights or a service pension. It would be nice to know that their wage scale would be improved comparative to the job evaluation, upgrading, type of aircraft and normal cost of living increase.

These men deserve to be championed by our congressmen.

How about it, anybody care to take up the bat?

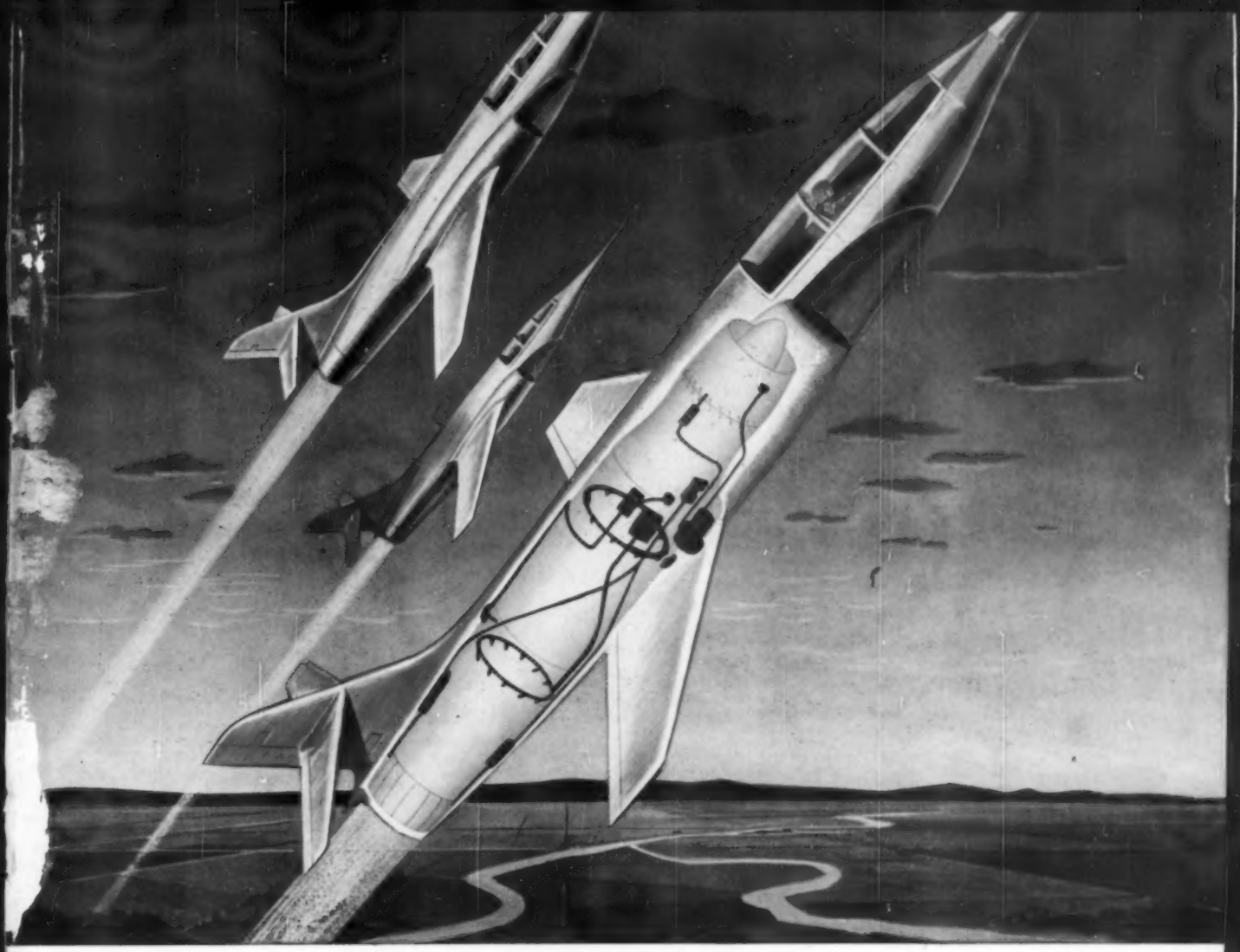
DALE O. HOUSEL
Element Leader, Jato Flight
Moore Air Base
Mission, Texas

Outmoded System

We appreciate the coverage you have given our work on the atomic oxygen recombination ramjet (AW Feb. 3, p. 29 and April 7, p. 65).

There is a minor error in the latter write-up: our figure of 10 mg. lift per cm^2 of lift-producing surface at Mach 2 at 100 km. altitude is equivalent to 0.02 lb./sq. ft. not 0.0002 as you stated. It is undoubtedly true that technological progress in this country is somewhat impeded by our insistence on the use of an outmoded system of weights and measures.

CARL B. KRETSCHMER
Astronautics Research Laboratory
Aerojet-General Corp.
Azusa, Calif.



TOWARD MACH 3

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